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Some Chemical Properties of the Profiles of Two Soil Series as Shown by Horizons and by Increments

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SOME CHEMICAL PROPERTIES OF THE PROFILES
OF TWO SOIL SERIES AS SHOWN BY
HORIZONS AND BY INCREMENTS

by

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INTRODUCTION

Soil classification in this country is based on the system proposed by Marbut in 1920 (2). This system uses eight criteria, one of which is the chemical composition of the soil horizons. Workers in the field of soil survey are depending more and more upon laboratory data to characterize and differentiate soils not only at the series level but also at higher levels of classification where it may be necessary to establish the presence or absence of critical horizons or characteristics. This was predicted by Robinson (16) when he said that laboratory analysis is needed to give "precise physical meaning to field descriptions" and that the importance of laboratory data increases as the classification of soils becomes more minute.

Thus there should exist a close correlation between field and laboratory data and the question arises as to how samples should be taken for laboratory analysis. Profiles for characterization are sampled by horizons with all of the soil from one horizon being mixed so that the horizon is, in effect, uniform throughout its depth (18). As a result, the data found on a sample represents an average for the horizon. This helps to describe that horizon but does not give a true picture of the distribution of the chemical properties either within the horizon or within the profile. This is shown in numerous places in the literature, some of which are cited here.

Brown and Drosdorff (3), in a study of chemical properties of desert soils, took samples by horizons but in their horizon descriptions they noted observable non-uniformities. They mentioned that the horizons graded into each other and that they graded into enriched zones within the horizon, indicating that the horizons were not uniform throughout their depth.

Lyford (10) used string to construct grids on exposed profiles in road cuts. He then made accurate drawings of the face square by square. His description of one profile contains five breakdowns in the A horizon and seven in the B. In addition to this, in areas which he labeled as B_{22} or B_{24}, for example, he drew dotted lines showing where visible differences occur within that area.

Joffe and Kolodny (9) said:

> The principle of soil zonality promulgated by pedology makes it 'categorically imperative' that the elements of fertility, and the level of fertility be zonal in nature. In their geographical distribution the broad units of our soils follow the principle enunciated, but the detailed features and behavior of the principle and minor elements of fertility in the various soil zones is still a 'terra incognita.'

They studied the distribution and fixation of potassium and found that potassium consistently increased in the B horizon with increasing depth.

These studies and others suggest the need to investigate the distribution of chemical properties in relation to horizons and horizon boundaries. This need is particularly apparent when profiles are being compared. It is difficult to compare profiles on the basis of their chemical analyses because profiles, even within a series, do not always have the same horizons. One profile may have a horizon sequence of Ap, B_{21}, B_{22}, B_{23}, B_3ca, Cca, for example, while another profile in the same series may have a horizon sequence of A_1p, A_{12}, B_2, B_2ca, Cca, C. It is obviously impossible to compare these profiles horizon by horizon.

Differences in horizon depths also present difficulties. For example, the A_1 horizon in one profile may be from 0 to 7 inches in depth while in another profile it may be from 0 to 13 inches in depth. For chemical properties which are related to rainfall or to temperature, comparisons between these horizons would not appear to be valid.

The work reported here was done to study the relationship between horizons and the distribution of some soil chemical properties. The properties studied were: pH of the soil paste, pH of the 1:5 suspension, electrical conductivity of the saturation extract, total soluble salts, organic carbon, total nitrogen, carbon-nitrogen ratio, and lime equivalent.

REVIEW OF LITERATURE

In order to observe the actual distribution of the chemical properties of a soil it is necessary to sample the soil in definite depth increments. Very little of this has been done which provides information pertinent to this type of study.

Norton and Bray (12) sampled soils by A and B horizons, then subdivided the horizons and determined pH on these subdivisions. On the soils which they studied, the variation in pH was as great within a horizon as between horizons. This suggests that in some soils pH follows a gradient independent of horizons. Contrarily, on a slick spot soil which was included in the study they reported a good correlation between pH and characteristics observed in the field such as texture and structure.

Doyne (5) sampled acid soils by depth increments to study the pH profile. He found that acidity steadily increased with depth to a certain point which differed for different soils. His explanation for the zone of high acidity was that during dry seasons salts moved downward from this zone by gravity and upward from the zone by evaporation.

Haas and Compton (7) obtained pH values for 6- and 12-inch depth intervals of acid soils in California. They found that the pH was lower at 6 inches than on the surface but it increased in the next interval and continued to increase as depth increased.

In a phosphorus study, Stephenson and Chapman (19) sampled citrus orchards by 6-inch increments and on each increment they determined phosphorus as both water soluble and soluble in 0.002 N H_2SO_4. They found that water soluble phosphorus decreased while acid soluble phosphorus increased with depth, with a zone of phosphorus accumulation occurring below about 24 to 36 inches. They suggest that the rate of movement of phosphorus is governed by the fixing power of the soil, which, in turn, suggests a relationship with soil texture.

Ayers, et al. (1), using 6-inch increments, found that exchangeable potassium decreased sharply through the first 12 to 24 inches but that it could either increase, decrease, or remain constant below that depth.

Nitrate nitrogen was found by Snow and Green (17) to increase gradually to a depth of 30 to 42 inches, depending on the profile chosen, then increase suddenly. This increase was on the order of two- to three-fold. They related the depth to this increase with the amount of rainfall and made no suggestion that this depth was related to horizons.

In none of these studies was an attempt made to compare increment sampling with horizonal sampling, and, indeed, no such work has been found. Therefore, this study was undertaken to evaluate the results found from the two methods of sampling.

METHODS OF PROCEDURE

The two soil series which were chosen for this study were Mendon and Parleys, both of which are prominent in northern Utah. Special care was taken in choosing sampling sites to obtain profiles which were as near to the modal concept and which had as little variation between the separate profiles within each series as possible.

Each soil series was sampled at three locations which were from one to twenty miles apart. Sampling was done with a core sampling machine which takes a 4-inch undisturbed core to a depth of six feet. At each location, two cores were taken within a few inches of each other and samples from them composited to provide a large enough sample for all of the analyses. The cores were sampled by dividing them lengthwise with one side of the core being sampled by horizons and the other side by 2-inch increments. These samples were taken to the laboratory where they were air-dried and ground to pass a 2-mm. sieve. A subsample was taken and ground to approximately 40-mesh for the determination of organic carbon, total nitrogen, and lime equivalent.

Saturated pastes were made (20, p. 84) of each of the soils and allowed to stand overnight. They were then checked and adjusted, if necessary, by the addition of more water or soil to the saturation point. The pH was then determined using a Beckman Model H-2 pH meter with glass-calomel electrode system (20, p. 102). The pH of the 1:5 soil-water syspension (pH_5) (20, p. 102) was also determined with this pH meter.

Total soluble salts (20, p. 91) was estimated from the electrical resistance of the saturated paste measured in a Bureau of Soils cup. The saturation extracts (20, p. 84) were obtained from the pastes and conductivity measurements (EC_e) (20, p. 89) were made using a pipette conductivity cell.

Lime equivalent was measured by the manometer method described by Williams (22). This involves the reaction of soil and hydrochloric acid while holding the volume constant and measuring the pressure of the evolved CO_2.

Total nitrogen was determined by a modification of the Kjeldahl method described by Prince (13). This modified method consists of digestion with H_2SO_4 and selenium oxychloride (thus cutting the digestion time to about one-half hour), distilling the ammonia into boric acid, and titrating with standard H_2SO_4 using a mixed indicator of bromcresol green and methyl red.

The determination of organic carbon was made by a modification of the method reported by the U. S. Regional Salinity Laboratory (20, p. 105-106). In this modification no ferroin indicator was used, but an excess (25 ml.) of 0.5 N ferrous ammonium sulfate was added and the solution titrated with standard potassium permanganate.

Duplicate analyses were run on all of the samples for lime equivalent, organic carbon, and total nitrogen. For the other analyses only enough duplicates were run to establish the standard error of the analysis. Horizon and increment samples were analyzed together so that any one group of analyses contained both horizon and increment samples. All of the analytical work was performed by the author.

DESCRIPTION OF SOILS

The profiles used in this study are approximately modal for the series which they represent.[1]

The Mendon soils are well-developed and well-drained Chernozem soils and are found on old lake terraces in Cache Valley in Utah. They are dark grayish brown in the surface horizons becoming lighter colored with increasing depth until the Cca horizon is nearly white. The texture is silt loam or silty clay loam throughout the profile. The primary structure ranges from platy in the A horizon to prismatic in the B horizon to massive in the C horizon. The secondary structure is granular to platy in the A horizon and angular blocky to subangular blocky in the B horizon. There is little or no lime in the surface but it increases rapidly at a depth of 2 to 2½ feet. It was primarily on the basis of structure and lime that horizon differentiations were made on the Mendon soils.

The Parleys soils are well-drained and well-developed Chestnut soils and were found on old lake terraces in Weber County, Utah. They are dark grayish brown in the surface grading to pale brown or light yellowish brown in the subsoil. The texture is silt loam in the A horizon, becoming silty clay loam or silty clay in the B horizon and back to sandy loam or silty clay loam in the C horizon. The primary structure is platy or granular in the A horizon, subangular blocky to prismatic in the B horizon, and massive in the C horizon. The secondary

1. Sites were chosen and the profiles described by LeMoyne Wilson, Agronomy Department, Utah State University.

structure is granular in the A horizon and subangular blocky in the B horizon. Lime is negligible to a depth of 2 to 3 feet but is very pronounced below that depth. Horizons were designated mainly on the basis of structure and lime.

More complete descriptions of these profiles are in the Appendix.

RESULTS

The results of this study are presented in an arrangement which is intended to show, as much as possible, comparisons between comparable determinations. Thus, pH and pH of the 1:5 soil-water suspension (pH_5) data are found together, total soluble salts (T.S.S.) and saturation extract conductivity (EC_e) are together, and organic carbon and total nitrogen together. Lime equivalent data are shown separately.

pH and pH_5

The data obtained in this study for pH and pH_5 are found in figures 1 through 6 and tables 1 through 6.

Some general statements can be made for all of the profiles. The figures show that both paste pH and pH_5 are highly erratic even though the values obtained can be duplicated with reasonable precision. The figures also show that for each of the profiles studied the general shape of the pH and pH_5 curves is very similar. This indicates that in these soils the relative amounts of hydrogen and other ions which affect pH and which were brought into solution were not changed greatly by increasing the dilution. While it might be expected that pH and pH_5 values obtained for a horizon would be close to the average of the values obtained by increments for the corresponding depth, this is not often the case.

It is recognized that "average" pH values may not be a valid term since the average of a group of pH values will differ slightly from the value obtained by converting the individual pH values to H-ion

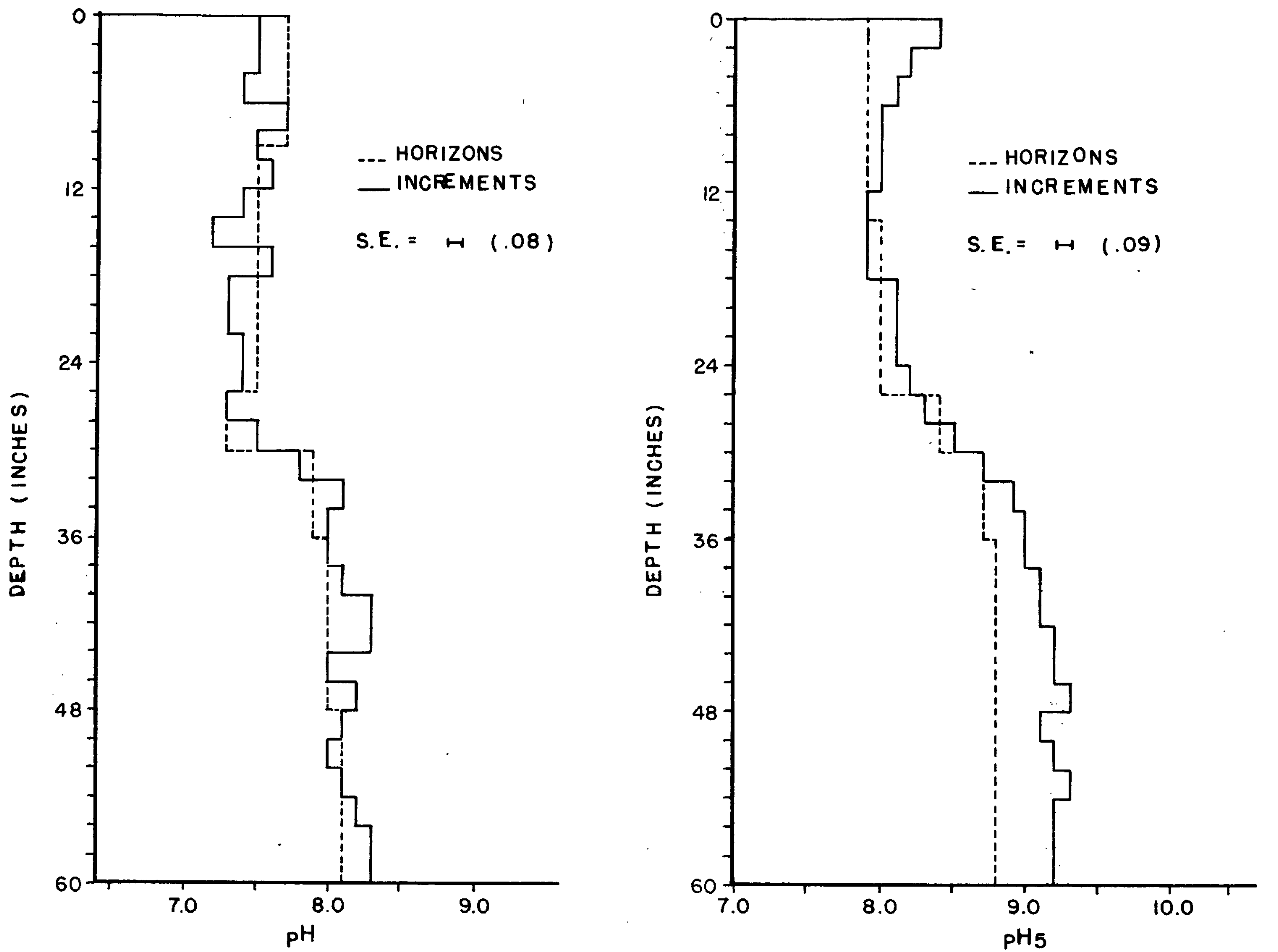
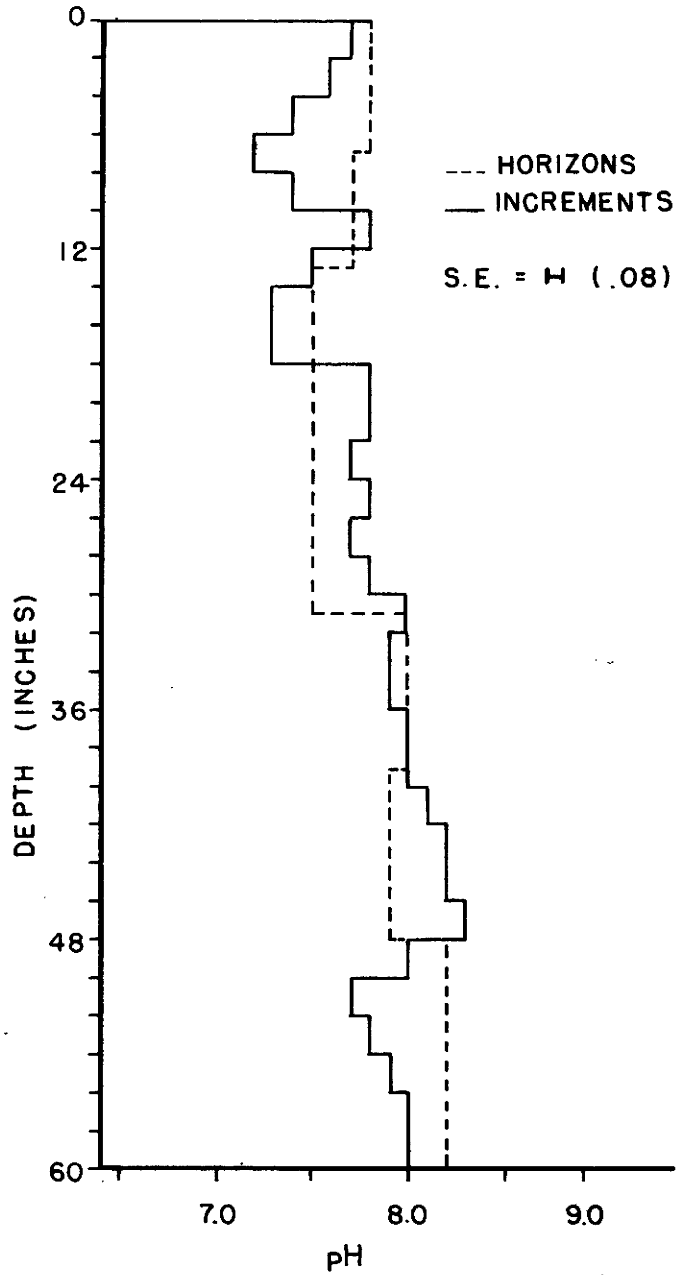


Figure 1. pH of soil paste and of 1:5 soil-water suspension of Mendon profile no. 1 by horizons and by increments



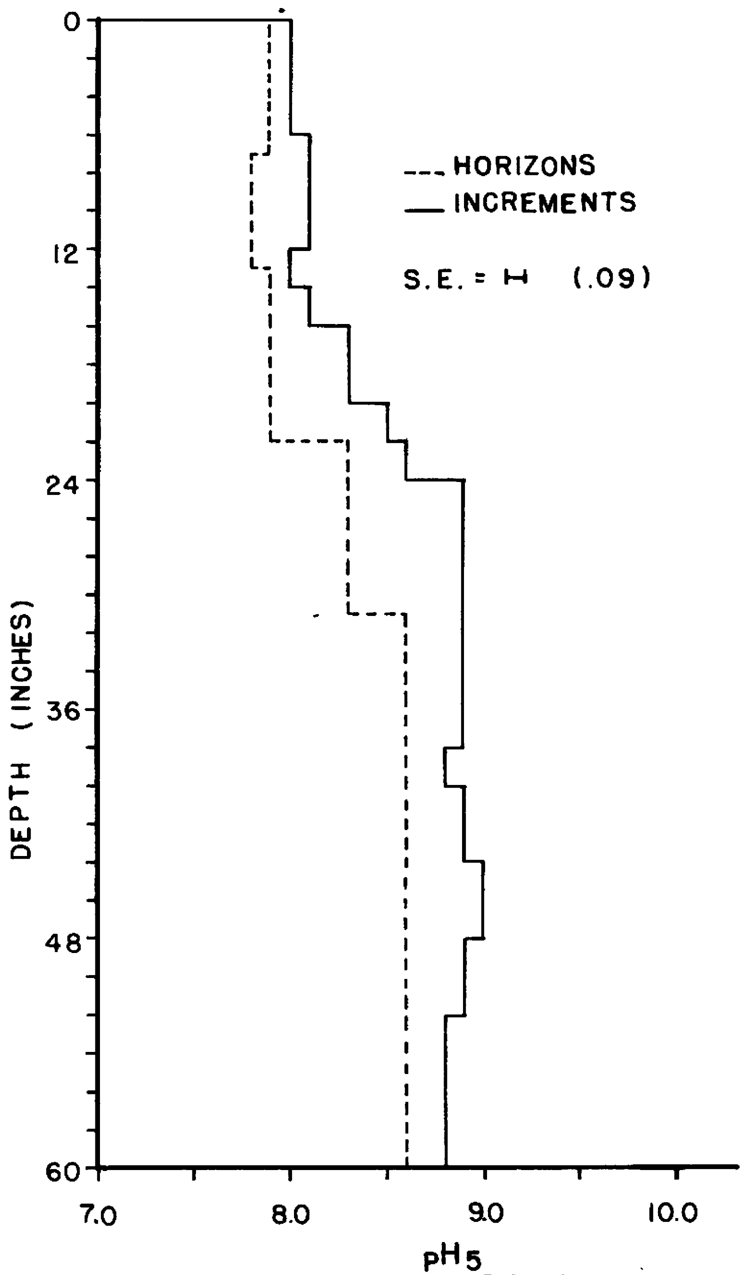


Figure 2. pH of soil paste and of 1:5 soil-water suspension of Mendon profile no. 2 by horizons and by increments

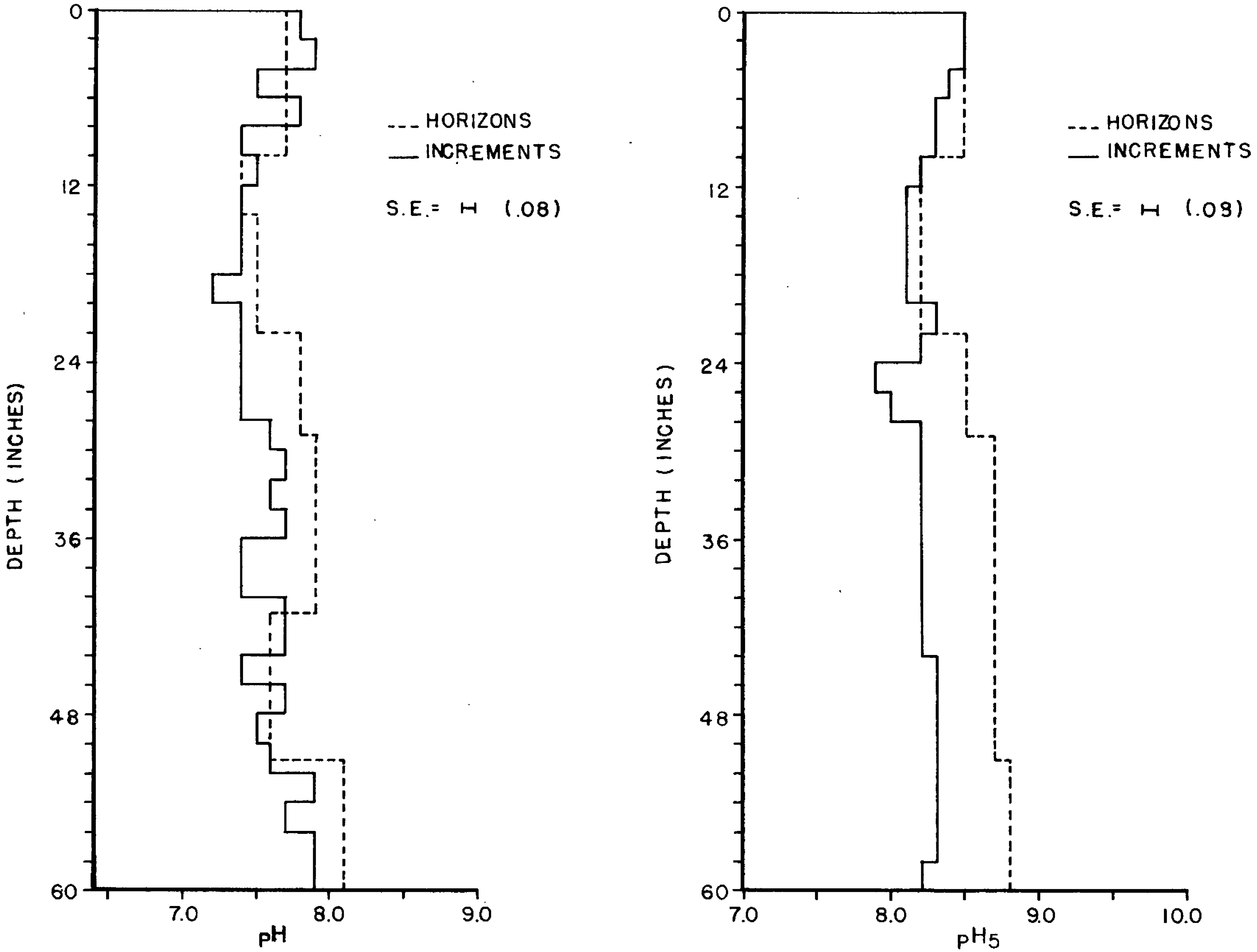


Figure 3. pH of soil paste and of 1:5 soil-water suspension of Mendon profile no. 3 by horizons and by increments

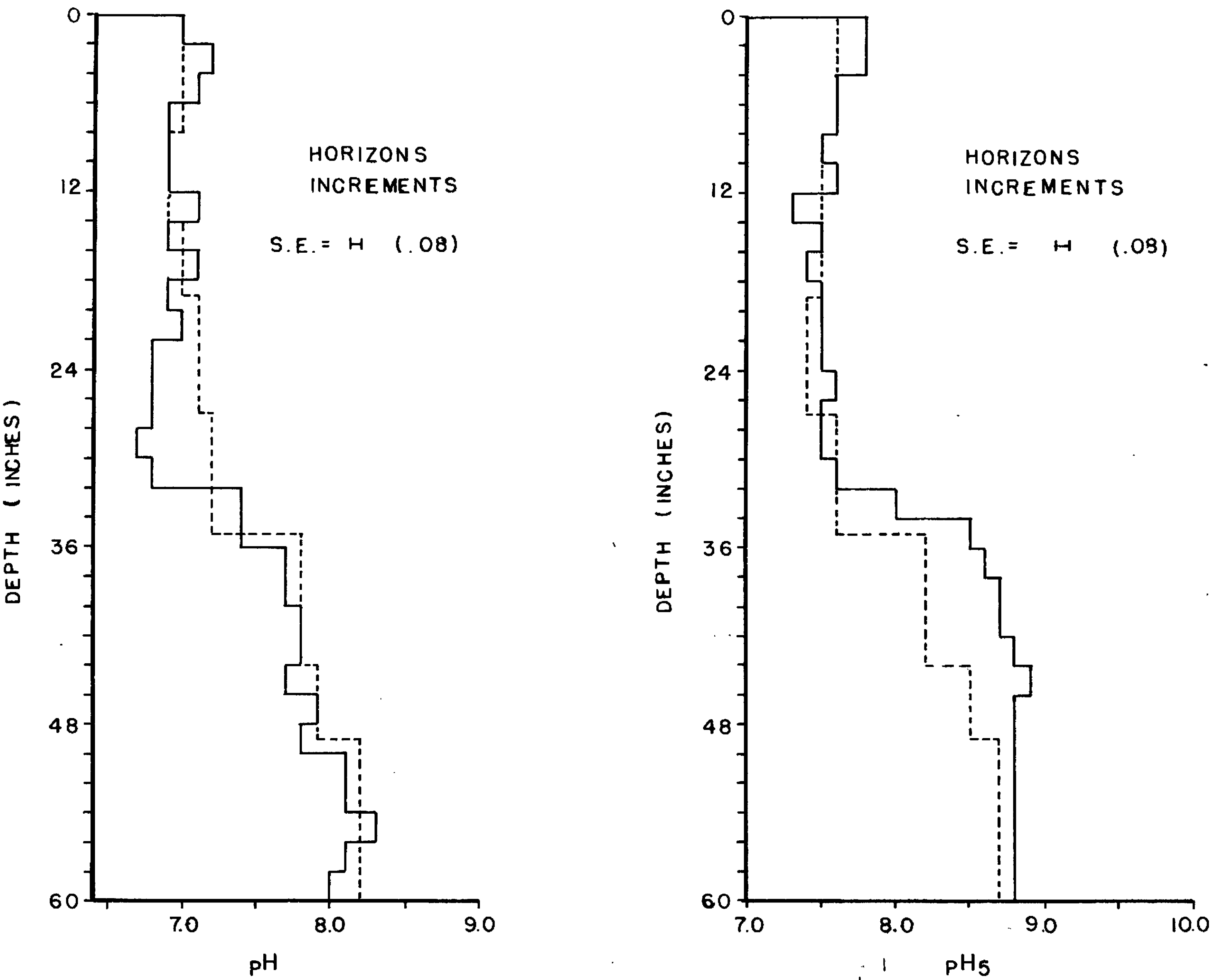
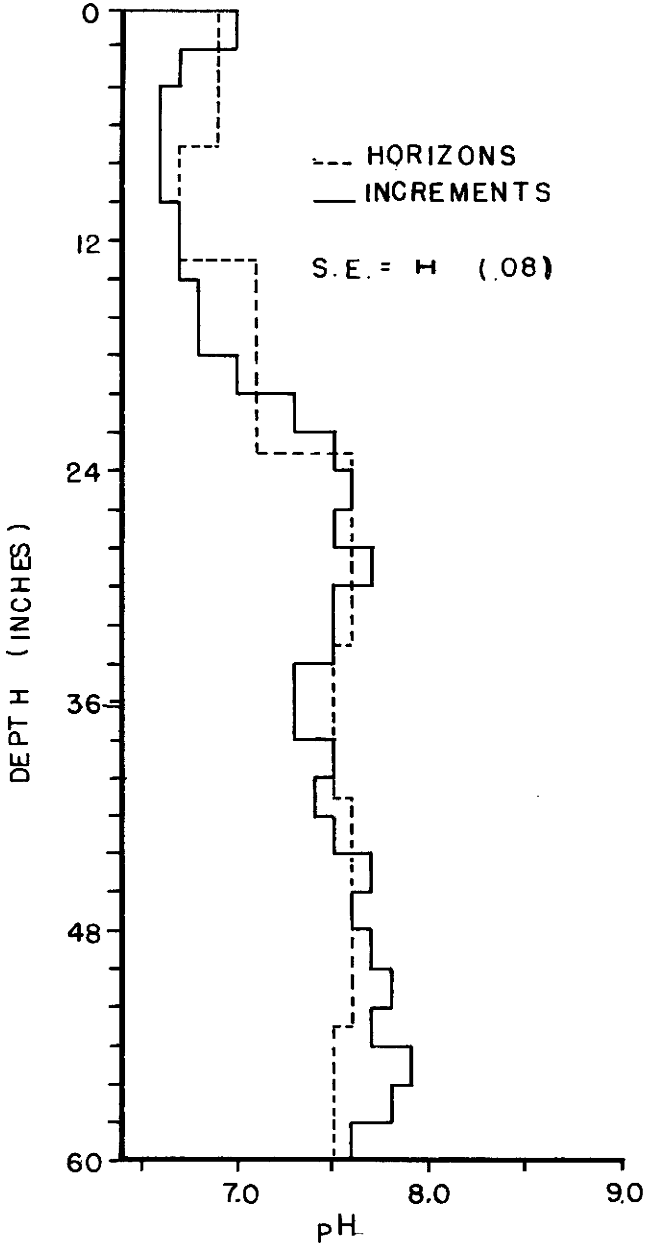


Figure 4. pH of soil paste and of 1:5 soil-water suspension of Parleys profile no. 1 by horizons and by increments



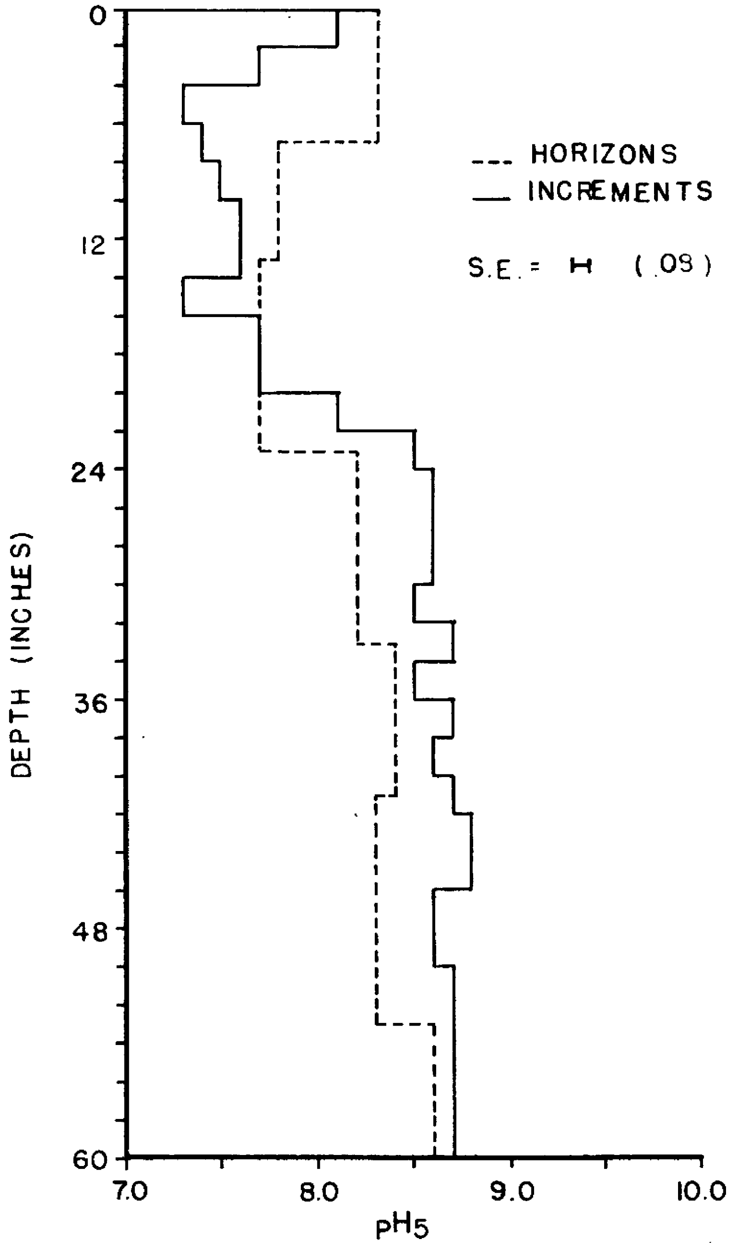


Figure 5. pH of soil paste and of 1:5 soil-water suspension of Parleys profile no. 2 by horizons and by increments

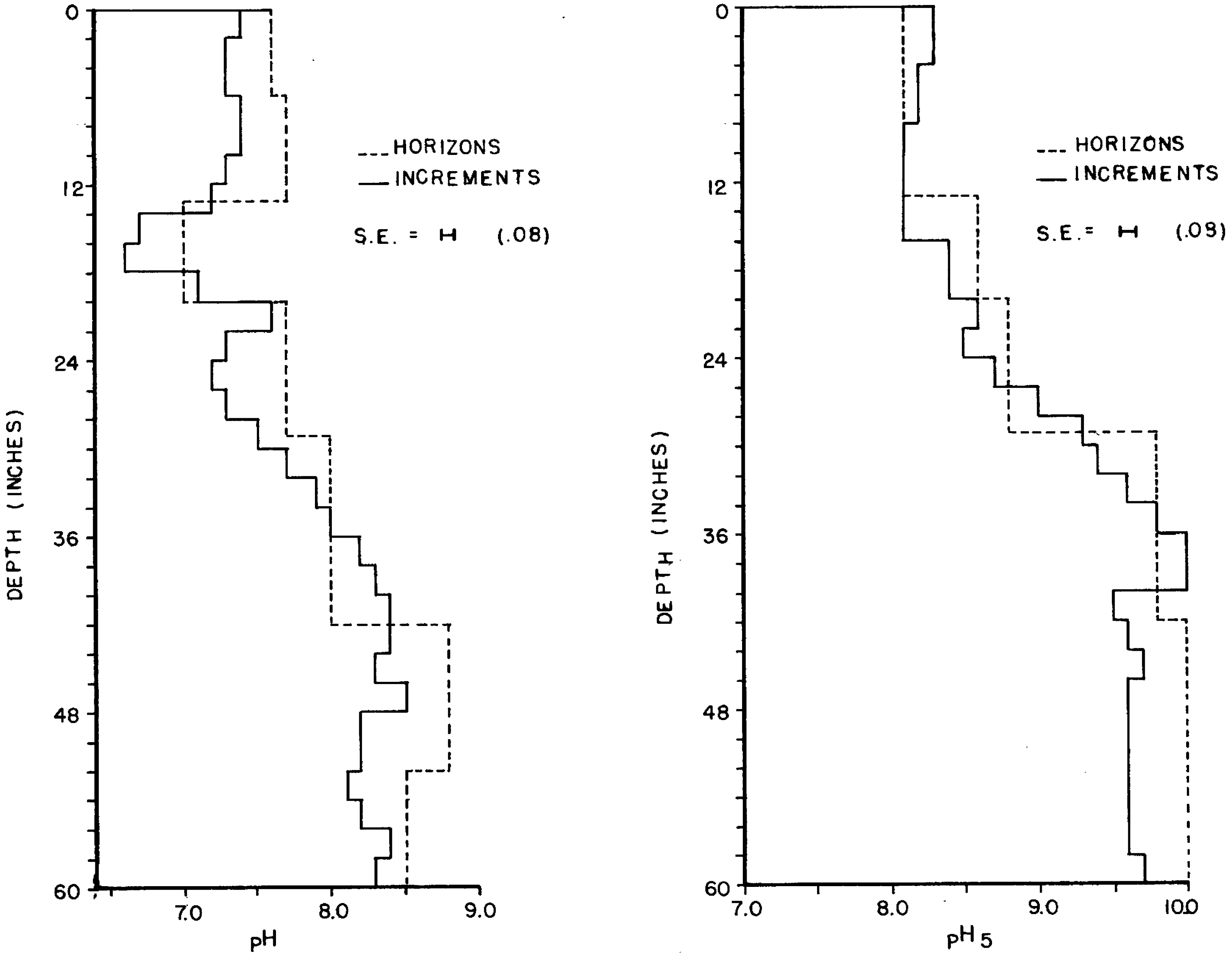


Figure 6. pH of soil paste and of 1:5 soil-water suspension of Parleys profile no. 3 by horizons and by increments

Table 1. pH of soil paste and of 1:5 soil-water suspension of Mendon profile no. 1 by horizons and by increments

Depth*	Horizon	pH		pH_5	
		Horizon	Increment	Horizon	Increment
inches					
0-2	Ap	7.7	7.5	7.9	8.4
2-4			7.5		8.2
4-6			7.4		8.1
6-8			7.7		8.0
8-10	B21	7.5	7.5	7.9	8.0
10-12			7.6		8.0
12-14			7.4		7.9
14-16	B22	7.5	7.2	8.0	7.9
16-18			7.6		7.9
18-20			7.3		8.1
20-22			7.3		8.1
22-24			7.4		8.1
24-26			7.4		8.2
26-28	B23	7.3	7.3	8.4	8.3
28-30			7.5		8.5
30-32	B3ca	7.9	7.8	8.7	8.7
32-34			8.1		8.9
34-36			8.0		9.0
36-38	Cca	8.0	8.0	9.0	9.0
38-40			8.1		9.1
40-42			8.3		9.1
42-44			8.3		9.2
44-46			8.0		9.2
46-48			8.2		9.3
48-50	Cca	8.1	8.1	9.0	9.1
50-52			7.9		9.2
52-54			8.0		9.3
54-56			8.1		9.2
56-58			8.3		9.2
58-60			8.3		9.2

* The brackets on this and the other tables indicate the increments which make up each horizon.

Table 2. pH of soil paste and of 1:5 soil-water suspension of Mendon profile no. 2 by horizons and by increments

Depth	Horizon	pH Horizon	pH Increment	pH_5 Horizon	pH_5 Increment
inches					
0-2			7.7		8.0
2-4			7.6		8.0
4-6	A_{1p}	7.8	7.4	7.9	8.0
6-8			7.2		8.1
8-10			7.4		8.1
10-12	A_{12}	7.7	7.8	7.8	8.1
12-14			7.5		8.0
14-16			7.3		8.1
16-18	B_2	7.5	7.3	7.9	8.3
18-20			7.8		8.3
20-22			7.8		8.5
22-24			7.7		8.6
24-26			7.8		8.9
26-28	B_2ca	7.5	7.7	8.3	8.9
28-30			7.8		8.9
30-32			8.0		8.9
32-34			7.9		8.9
34-36	Cca	8.0	7.9	8.6	8.9
36-38			8.0		8.9
38-40			8.0		8.8
40-42			8.1		8.9
42-44	Cca	7.9	8.2	8.6	8.9
44-46			8.2		9.0
46-48			8.3		9.0
48-50			8.0		8.9
50-52			7.7		8.9
52-54	Cca	8.2	7.8	8.6	8.8
54-56			7.9		8.8
56-58			8.0		8.8
58-60			8.0		8.8

Table 3. pH of soil paste and of 1:5 soil-water suspension of Mendon profile no. 3 by horizons and by increments

Depth	Horizon	pH		pH_5	
		Horizon	Increment	Horizon	Increment
inches					
0-2			7.8		8.5
2-4			7.9		8.5
4-6	Ap	7.7	7.5	8.5	8.4
6-8			7.8		8.3
8-10			7.4		8.3
10-12	B_1	7.4	7.5	8.2	8.2
12-14			7.4		8.1
14-16			7.4		8.1
16-18	B_2	7.5	7.4	8.2	8.1
18-20			7.2		8.1
20-22			7.4		8.3
22-24			7.4		8.2
24-26	B_2ca	7.8	7.4	8.5	7.9
26-28			7.4		8.0
28-30			7.6		8.2
30-32			7.7		8.2
32-34			7.6		8.2
34-36	Cca	7.9	7.7	8.7	8.2
36-38			7.4		8.2
38-40			7.4		8.2
40-42			7.7		8.2
42-44			7.7		8.2
44-46	Cca	7.6	7.4	8.7	8.3
46-48			7.7		8.3
48-50			7.5		8.3
50-52			7.6		8.3
52-54			7.9		8.3
54-56	Cca	8.1	7.7	8.8	8.3
56-58			7.9		8.3
58-60			7.9		8.2

Table 4. pH of soil paste and of 1:5 soil-water suspension of Parleys profile no. 1 by horizons and by increments

Depth	Horizon	pH		pH_5	
		Horizon	Increment	Horizon	Increment
inches					
0-2	A_{11}	7.0	7.0	7.6	7.8
2-4			7.2		7.8
4-6			7.1		7.6
6-8			6.9		7.6
8-10	A_{12}	6.9	6.9	7.5	7.5
10-12			6.9		7.6
12-14			7.1		7.3
14-16	B_{21}	7.0	6.9	7.5	7.5
16-18			7.1		7.4
18-20	B_{21}	7.1	6.9	7.4	7.5
20-22			7.0		7.5
22-24			6.8		7.5
24-26			6.8		7.6
26-28	B_{22}	7.2	6.8	7.6	7.5
28-30			6.7		7.5
30-32			6.8		7.6
32-34			7.4		8.0
34-36	Cca	7.8	7.4	8.2	8.5
36-38			7.7		8.6
38-40			7.7		8.7
40-42			7.8		8.7
42-44			7.8		8.8
44-46	C	7.9	7.7	8.5	8.9
46-48			7.9		8.8
48-50	C	8.2	7.8	8.7	8.8
50-52			8.1		8.8
52-54			8.1		8.8
54-56			8.3		8.8
56-58	C	8.2	8.1	8.7	8.8
58-60			8.0		8.8

Table 5. pH of soil paste and of 1:5 soil-water suspension of Parleys profile no. 2 by horizons and by increments

Depth	Horizon	pH		pH_5	
		Horizon	Increment	Horizon	Increment
inches					
0-2			7.0		8.1
2-4	Ap	6.9	6.7	8.3	7.7
4-6			6.6		7.3
6-8			6.6		7.4
8-10			6.6		7.5
10-12	AB	6.7	6.7	7.8	7.6
12-14			6.7		7.6
14-16			6.8		7.3
16-18			6.8		7.7
18-20	B_2	7.1	7.0	7.7	7.7
20-22			7.3		8.1
22-24			7.5		8.5
24-26			7.6		8.6
26-28			7.5		8.6
28-30	B_3ca	7.6	7.7	8.2	8.6
30-32			7.5		8.5
32-34			7.5		8.7
34-36			7.3		8.5
36-38	Cca_1	7.5	7.3	8.4	8.7
38-40			7.5		8.6
40-42			7.4		8.7
42-44			7.5		8.8
44-46			7.7		8.8
46-48	Cca_2	7.6	7.6	8.3	8.6
48-50			7.7		8.6
50-52			7.8		8.7
52-54			7.7		8.7
54-56			7.9		8.7
56-58	Cca_3	7.5	7.8	8.6	8.7
58-60			7.6		8.7

Table 6. pH of soil paste and of 1:5 soil-water suspension of Parleys profile no. 3 by horizons and by increments

Depth	Horizon	pH		pH_5	
		Horizon	Increment	Horizon	Increment
inches					
0-2			7.4		8.3
2-4	Ap	7.6	7.3	8.1	8.3
4-6			7.3		8.2
6-8			7.4		8.2
8-10			7.4		8.1
10-12	AB	7.7	7.3	8.1	8.1
12-14			7.2		8.1
14-16			6.7		8.1
16-18	B_2	7.0	6.6	8.6	8.4
18-20			7.1		8.4
20-22			7.6		8.6
22-24			7.3		8.5
24-26	B_2ca	7.7	7.2	8.8	8.7
26-28			7.3		9.0
28-30			7.5		9.3
30-32			7.7		9.4
32-34			7.9		9.6
34-36	Cca_1	8.0	8.0	9.8	9.8
36-38			8.2		10.0
38-40			8.3		10.0
40-42			8.4		9.5
42-44			8.4		9.6
44-46			8.3		9.7
46-48	Cca_2	8.8	8.5	10.0	9.6
48-50			8.2		9.6
50-52			8.2		9.6
52-54			8.1		9.6
54-56	C	8.5	8.2	10.0	9.6
56-58			8.4		9.6
58-60			8.3		9.7

concentration, averaging these concentrations and then converting back to pH. However, for the range in which the pH values fall for the soils used in this study, the error induced from averaging the pH values is smaller than the precision with which the pH was measured.

A fairly good comparison of horizon pH and average pH of the increments in the corresponding horizon can be made by comparing the increment values which fall below the horizon value to the increment values which fall above the horizon value. It can readily be seen that in most cases the horizon pH value is not the average of the pH values for the increments which make up the horizon. In many cases all of the increment pH values fall above or below the pH value for the corresponding horizon. This is particularly noticeable with the pH_5 values shown in figure 2. In this profile, all of the increment pH_5 values are higher than the corresponding horizon pH_5 values. This may be attributed to contamination or to analytical error, but since it is so consistent and occurs to a lesser degree in other profiles also, the difference is probably real and reflects the effects of factors other than soil character which are mentioned in the Discussion section of this paper. This is true also for the paste pH values, though here the actual differences between the increment and horizon values appear not to be as great as with pH_5.

T.S.S. and EC_e

The results of this study for total soluble salts (T.S.S.) and electrical conductivity of the saturation extract (EC_e) are contained in figures 7 through 12 and tables 7 through 12. There is noticeably less variation in the T.S.S. curves than in the EC_e curves, partly due to rounding error induced by estimating T.S.S. only to the nearest

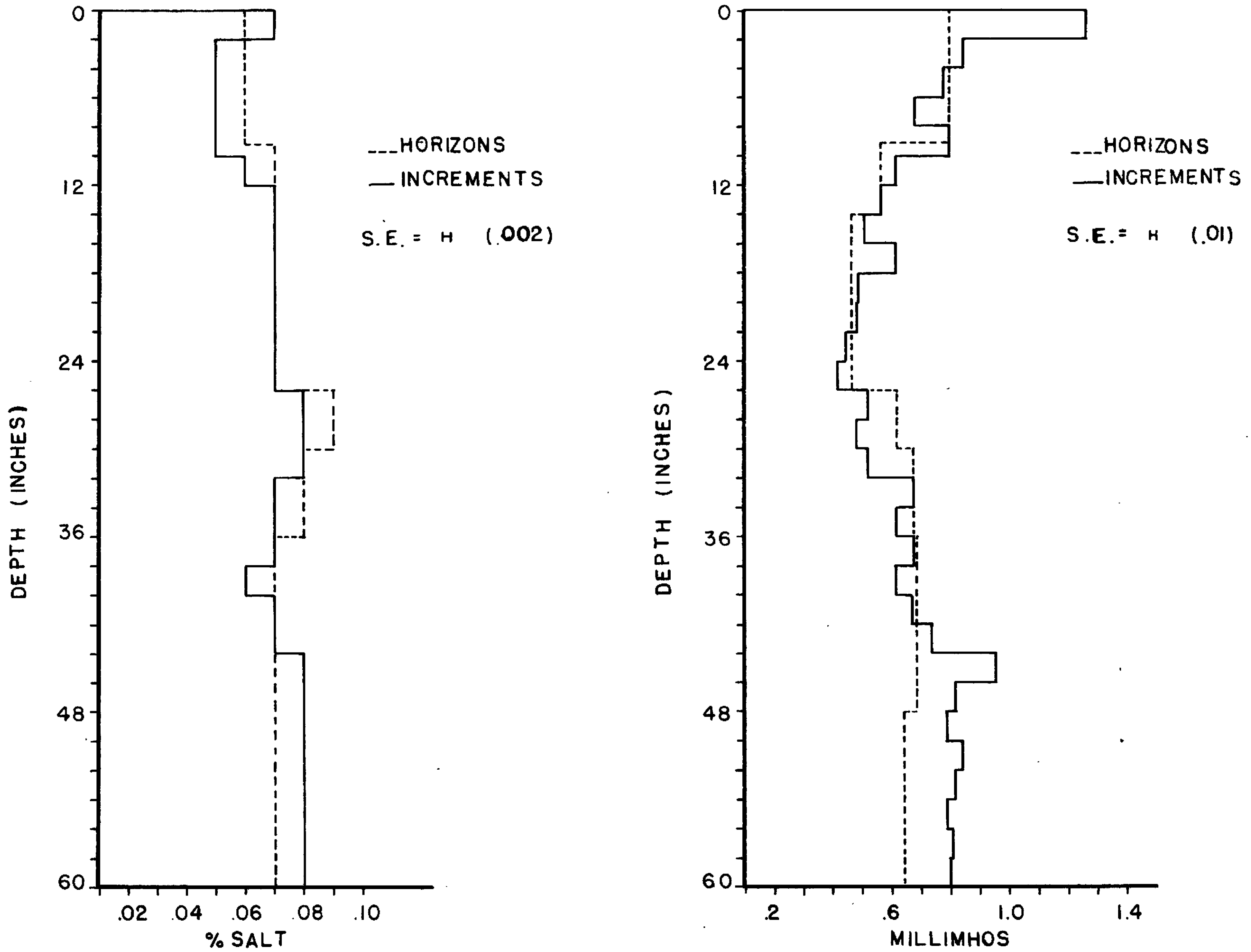
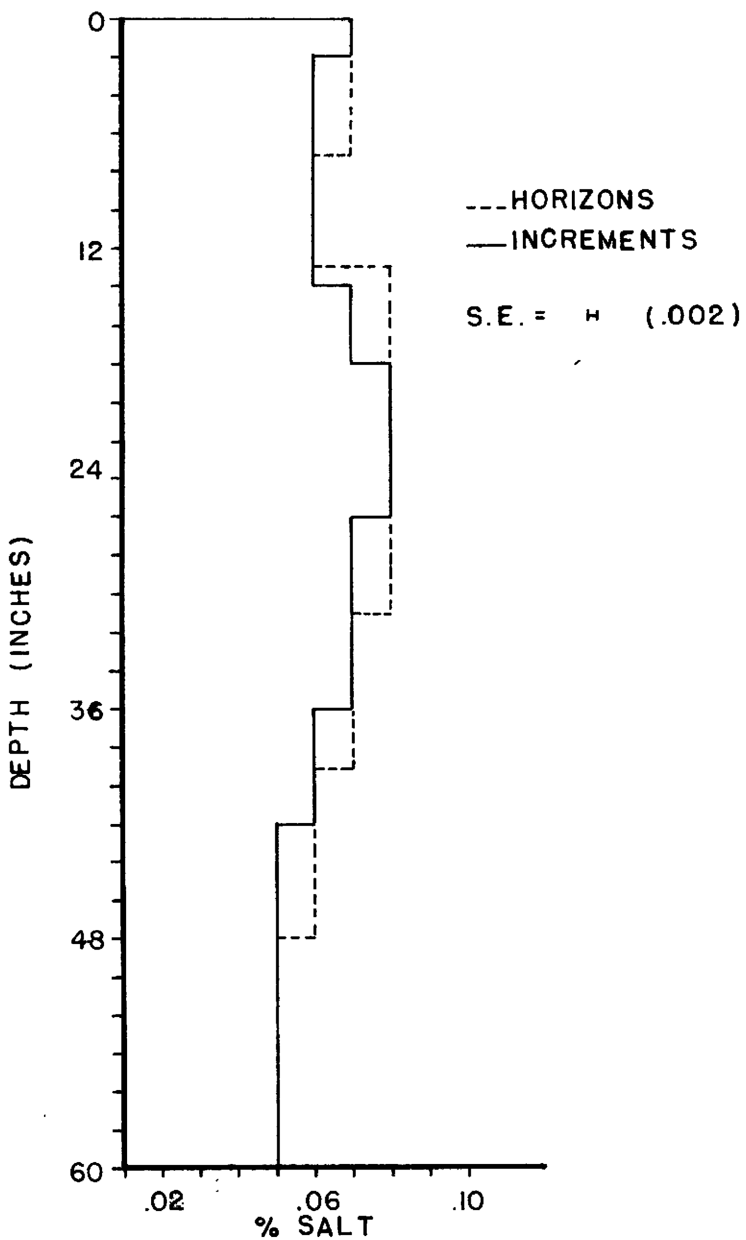


Figure 7. Total soluble salts content and saturation extract conductivity of Mendon profile No. 1 by horizons and by increments



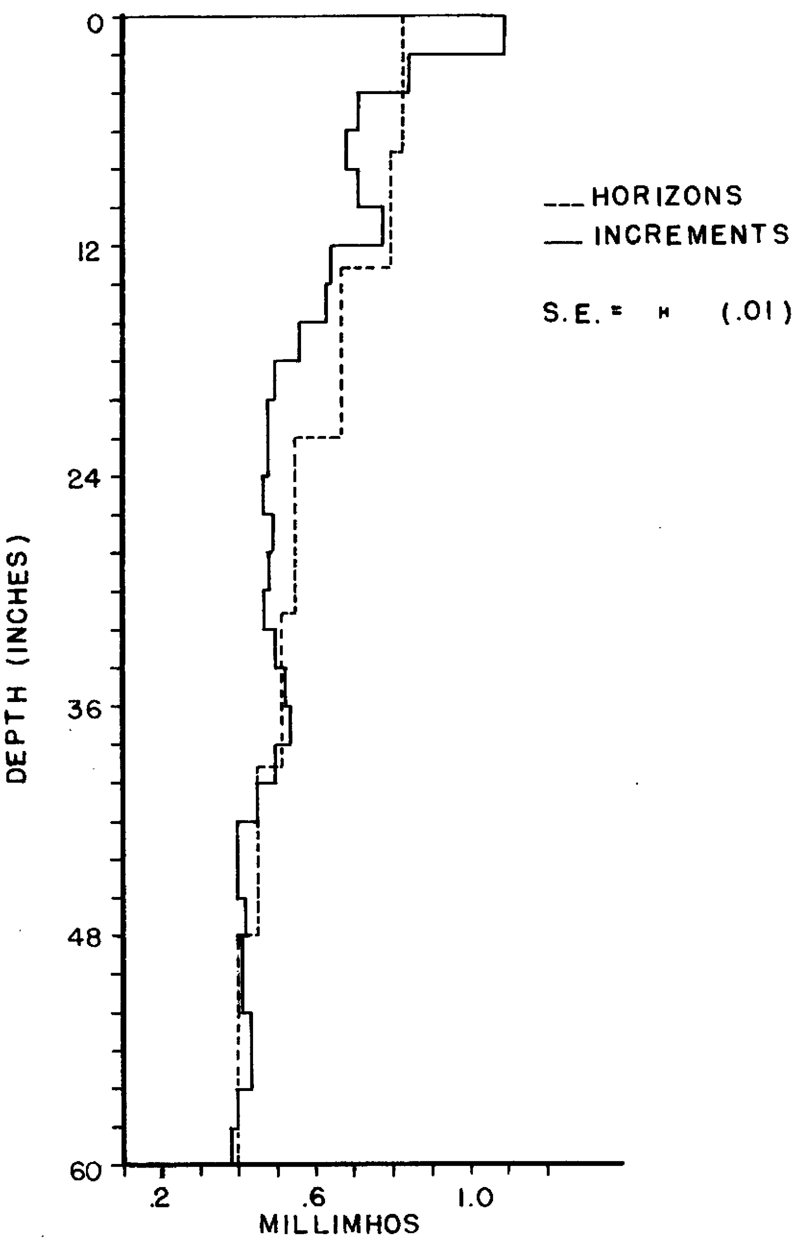


Figure 8. Total soluble salts content and saturation extract conductivity of Mendon profile no. 2 by horizons and by increments

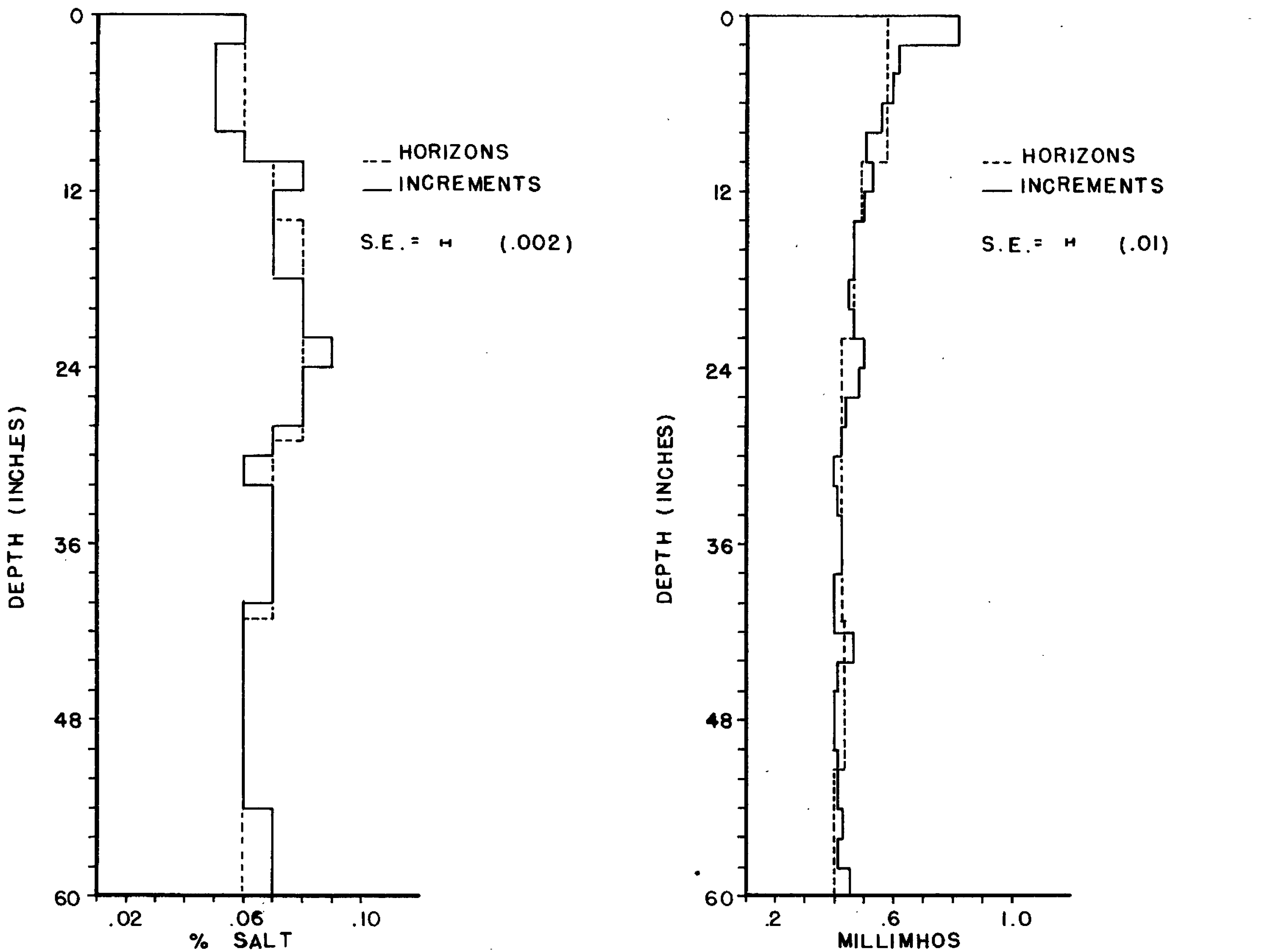


Figure 9. Total soluble salts content and saturation extract conductivity of Mendon profile no. 3 by horizons and by increments

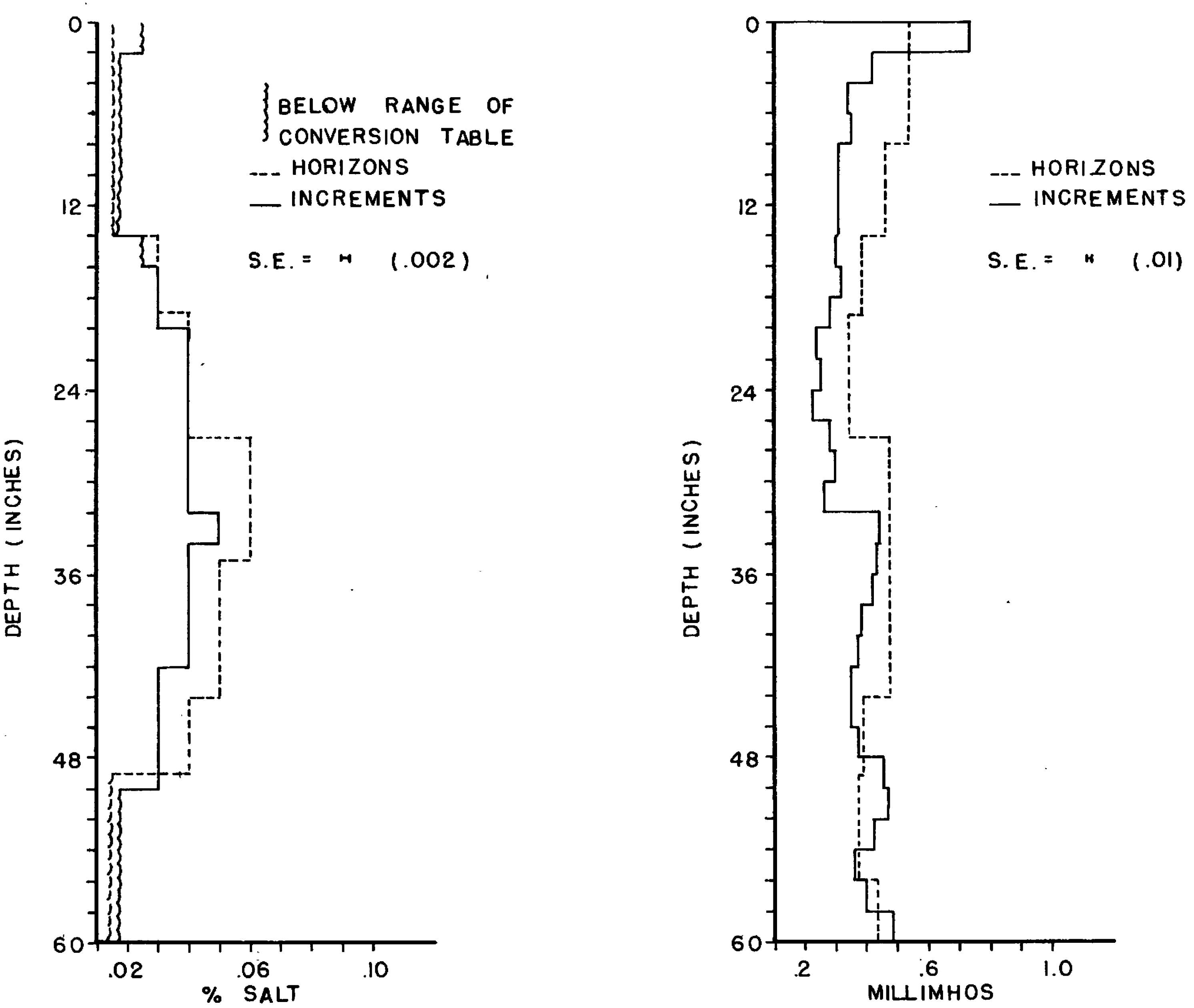
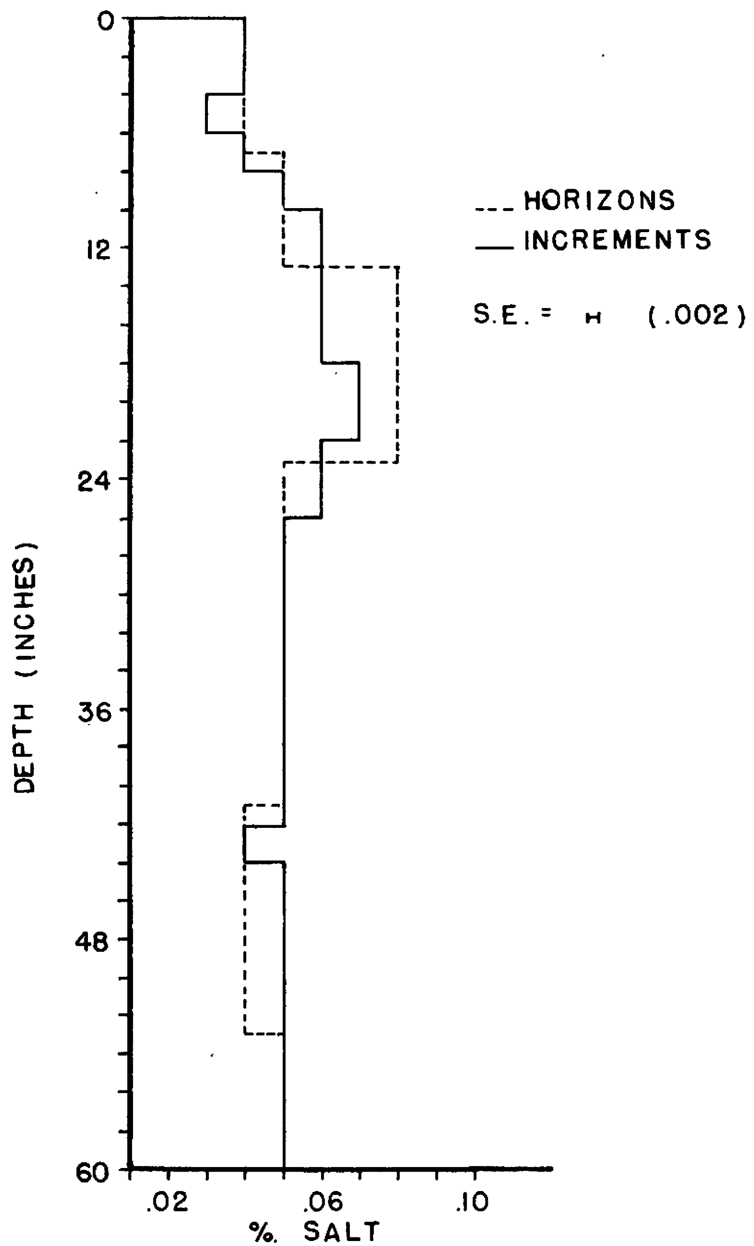


Figure 10. Total soluble salts content and saturation extract conductivity of Parleys profile no. 1 by horizons and by increments



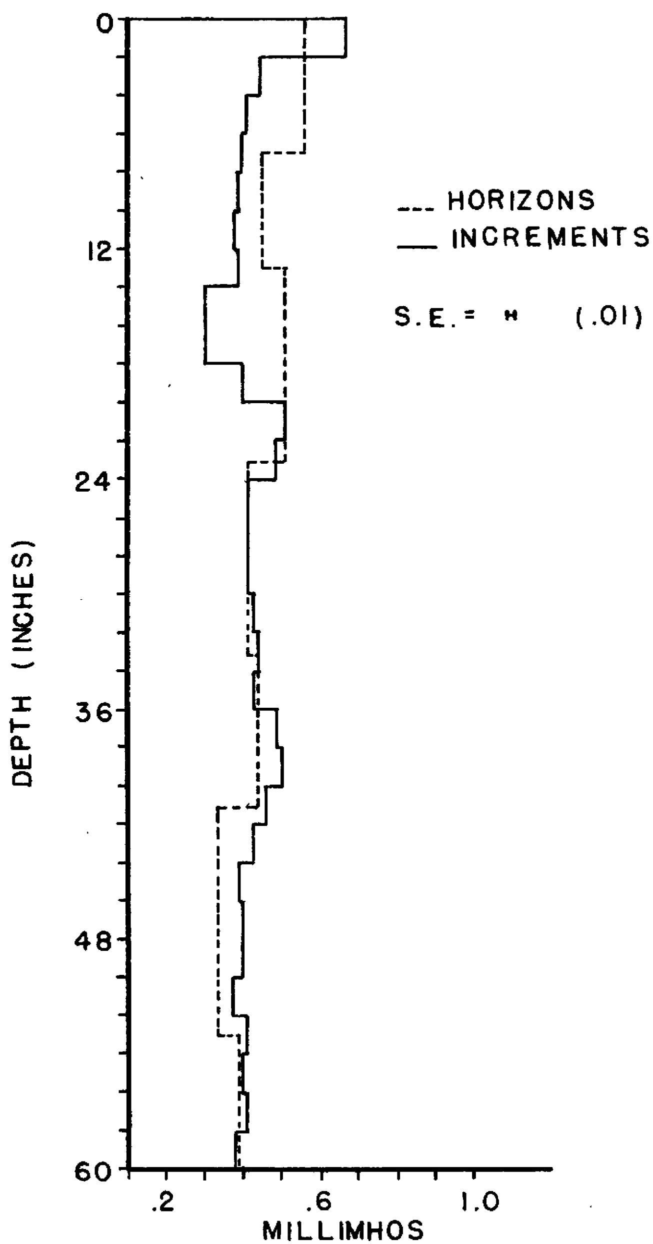


Figure 11. Total soluble salts content and saturation extract conductivity of Parleys profile no. 2 by horizons and by increments

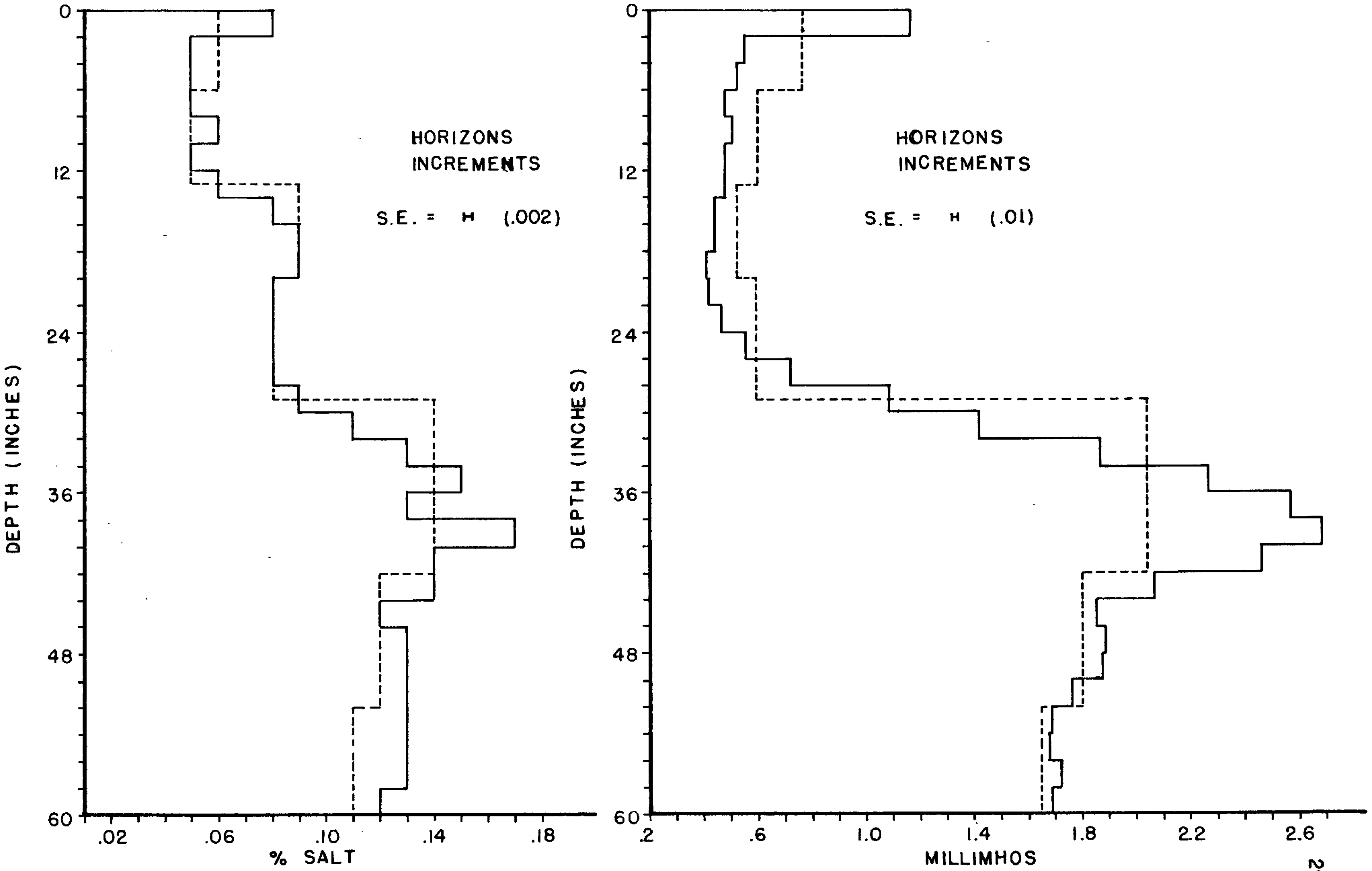


Figure 12. Total soluble salts content and saturation extract conductivity of Parleys profile no. 3 by horizons and by increments

Table 7. Total soluble salts content and saturation extract conductivity of Mendon profile no. 1 by horizons and by increments

Depth	Horizon	T. S. S.		EC_e	
		Horizon	Increment	Horizon	Increment
inches		percent	percent	mmhos/cm	mmhos/cm
0-2	Ap	0.06	0.07	0.80	1.26
2-4			0.05		0.84
4-6			0.05		0.78
6-8			0.05		0.68
8-10	B_{21}	0.07	0.05	0.56	0.80
10-12			0.06		0.62
12-14			0.07		0.56
14-16	B_{22}	0.07	0.07	0.46	0.51
16-18			0.07		0.61
18-20			0.07		0.49
20-22			0.07		0.48
22-24			0.07		0.44
24-26			0.07		0.41
26-28	B_{23}	0.09	0.08	0.62	0.52
28-30			0.08		0.48
30-32	B_3ca	0.08	0.08	0.67	0.52
32-34			0.07		0.67
34-36			0.07		0.62
36-38	Cca	0.07	0.07	0.68	0.67
38-40			0.06		0.61
40-42			0.07		0.66
42-44			0.07		0.73
44-46			0.08		0.95
46-48			0.08		0.82
48-50	Cca	0.07	0.08	0.64	0.78
50-52			0.08		0.84
52-54			0.08		0.82
54-56			0.08		0.78
56-58			0.08		0.81
58-60			0.08		0.80

Table 8. Total soluble salts content and saturation extract conductivity of Mendon profile no. 2 by horizons and by increments

Depth	Horizon	T. S. S. Horizon	T. S. S. Increment	EC_e Horizon	EC_e Increment
inches		percent	percent	mmhos/cm	mmhos/cm
0-2			0.07		1.10
2-4			0.06		0.85
4-6	A_{1p}	0.07	0.06	0.83	0.72
6-8			0.06		0.69
8-10			0.06		0.72
10-12	A_{12}	0.06	0.06	0.80	0.78
12-14			0.06		0.65
14-16			0.07		0.64
16-18	B_2	0.08	0.07	0.67	0.56
18-20			0.08		0.50
20-22			0.08		0.48
22-24			0.08		0.48
24-26			0.08		0.46
26-28	B_{2ca}	0.08	0.07	0.55	0.49
28-30			0.07		0.48
30-32			0.07		0.47
32-34			0.07		0.50
34-36	Cca	0.07	0.07	0.51	0.52
36-38			0.06		0.53
38-40			0.06		0.50
40-42			0.06		0.45
42-44	Cca	0.06	0.05	0.45	0.40
44-46			0.05		0.40
46-48			0.05		0.42
48-50			0.05		0.41
50-52			0.05		0.41
52-54	Cca	0.05	0.05	0.40	0.43
54-56			0.05		0.43
56-58			0.05		0.40
58-60			0.05		0.38

Table 9. Total soluble salts content and saturation extract conductivity of Mendon profile no. 3 by Horizons and by increments

Depth	Horizon	T. S. S. Horizon	T. S. S. Increment	EC_e Horizon	EC_e Increment
inches		percent	percent	mmhos/cm	mmhos/cm
0-2	Ap	0.06	0.06	0.58	0.82
2-4			0.05		0.62
4-6			0.05		0.60
6-8			0.05		0.56
8-10			0.06		0.51
10-12	B_1	0.07	0.08	0.49	0.53
12-14			0.07		0.50
14-16	B_2	0.08	0.07	0.46	0.46
16-18			0.07		0.46
18-20			0.08		0.44
20-22			0.08		0.46
22-24	B_2ca	0.08	0.09	0.42	0.50
24-26			0.08		0.48
26-28			0.08		0.43
28-30	Cca	0.07	0.07	0.42	0.42
30-32			0.06		0.40
32-34			0.07		0.41
34-36			0.07		0.42
36-38			0.07		0.42
38-40			0.07		0.40
40-42	Cca	0.06	0.06	0.43	0.40
42-44			0.06		0.46
44-46			0.06		0.41
46-48			0.06		0.40
48-50			0.06		0.40
50-52	Cca	0.06	0.06	0.40	0.41
52-54			0.06		0.41
54-56			0.07		0.43
56-58			0.07		0.41
58-60			0.07		0.45

Table 10. Total soluble salts content and saturation extract conductivity of Parleys profile no. 1 by horizons and by increments

Depth	Horizon	T. S. S. Horizon	T. S. S. Increment	EC_e Horizon	EC_e Increment
inches		percent	percent	mmhos/cm	mmhos/cm
0-2	A_{11}	< 0.02	< 0.03	0.54	0.73
2-4			< 0.02		0.42
4-6			< 0.02		0.34
6-8			< 0.02		0.35
8-10	A_{12}	< 0.02	< 0.02	0.46	0.31
10-12			< 0.02		0.31
12-14			< 0.02		0.31
14-16	B_{21}	0.03	< 0.03	0.39	0.30
16-18			0.03		0.32
18-20	B_{21}	0.04	0.03	0.34	0.28
20-22			0.04		0.24
22-24			0.04		0.25
24-26			0.04		0.22
26-28	B_{22}	0.06	0.04	0.47	0.28
28-30			0.04		0.30
30-32			0.04		0.26
32-34			0.05		0.44
34-36	Cca	0.05	0.04	0.47	0.43
36-38			0.04		0.42
38-40			0.04		0.38
40-42			0.04		0.37
42-44			0.03		0.35
44-46	C	0.04	0.03	0.39	0.35
46-48			0.03		0.37
48-50	C	< 0.02	0.03	0.37	0.45
50-52			< 0.02		0.46
52-54			< 0.02		0.42
54-56			< 0.02		0.36
56-58	C	< 0.02	< 0.02	0.43	0.40
58-60			< 0.02		0.48

Table 11. Total soluble salts content and saturation extract conductivity of Parleys profile no. 2 by horizons and by increments

Depth	Horizon	T. S. S.		EC_e	
		Horizon	Increment	Horizon	Increment
inches		percent	percent	mmhos/cm	mmhos/cm
0-2	Ap	0.04	0.04	0.56	0.67
2-4			0.04		0.45
4-6			0.03		0.41
6-8	AB	0.05	0.04	0.45	0.40
8-10			0.05		0.39
10-12			0.06		0.38
12-14	B_2	0.08	0.06	0.51	0.39
14-16			0.06		0.30
16-18			0.06		0.30
18-20			0.07		0.40
20-22			0.07		0.51
22-24	B_3ca	0.05	0.06	0.41	0.48
24-26			0.06		0.41
26-28			0.05		0.41
28-30			0.05		0.41
30-32			0.05		0.42
32-34	Cca_1	0.05	0.05	0.44	0.44
34-36			0.05		0.43
36-38			0.05		0.49
38-40			0.05		0.50
40-42	Cca_2	0.04	0.05	0.34	0.46
42-44			0.04		0.42
44-46			0.05		0.39
46-48			0.05		0.40
48-50			0.05		0.40
50-52			0.05		0.37
52-54	Cca_3	0.05	0.05	0.39	0.41
54-56			0.05		0.40
56-58			0.05		0.41
58-60			0.05		0.38

Table 12. Total soluble salts content and saturation extract conductivity of Parleys profile no. 3 by horizons and by increments

Depth	Horizon	T. S. S.		EC_e	
		Horizon	Increment	Horizon	Increment
inches		percent	percent	mmhos/cm	mmhos/cm
0-2	Ap	0.06	0.08	0.77	1.17
2-4			0.05		0.55
4-6			0.05		0.52
6-8	AB	0.05	0.05	0.60	0.48
8-10			0.06		0.51
10-12			0.05		0.48
12-14	B$_2$	0.09	0.06	0.52	0.48
14-16			0.08		0.44
16-18			0.09		0.44
18-20			0.09		0.41
20-22	B$_2$ca	0.08	0.08	0.59	0.42
22-24			0.08		0.47
24-26			0.08		0.55
26-28			0.08		0.72
28-30	Cca$_1$	0.14	0.09	2.04	1.09
30-32			0.11		1.42
32-34			0.13		1.86
34-36			0.15		2.27
36-38			0.13		2.56
38-40			0.17		2.68
40-42			0.14		2.46
42-44	Cca$_2$	0.12	0.14	1.80	2.06
44-46			0.12		1.85
46-48			0.13		1.88
48-50			0.13		1.87
50-52			0.13		1.76
52-54	C	0.11	0.13	1.65	1.68
54-56			0.13		1.67
56-58			0.13		1.72
58-60			0.12		1.69

0.01 percent.

It can readily be seen from the figures that the apparent distribution of salts differs according to the method of analysis used. Generally, the T.S.S. curves show that salt increases with increased depth to a certain point, then decreases again. The EC_e curves, on the other hand, indicate that the highest salt concentration is in the surface, with the exception of Parleys no. 3 shown in table 12 and figure 12. This profile still shows, however, a higher concentration of salt in the surface increment than in the increment below it. This can be explained by the concentration of salts resulting from evaporation of moisture from the soil surface.

The differences between the horizon values and the increment values for T.S.S. in these soils are small and do not indicate that a real difference exists between the two. As mentioned above, this is partly due to rounding error in converting resistance measurements to percent salt.

The EC_e curves for horizons all indicate that there is a decrease in salt in going from the surface horizon to the underlying horizon. The increment curves, however, indicate that the greatest decrease in salt occurs between the first two increments. In all cases this decrease is much larger than the decrease between the first two horizons. In other words, the EC_e for the surface 2 inches is higher than the horizon values would indicate. Since this is the part of the profile in which planting is done and in which many of the plant's feeder roots are located, it seems that the actual amount of salt in this increment may be more important than the more nearly average value for the salt content of the horizon as a whole.

The Parleys no. 3 profile, whose data are seen in table 12 and figure 12, contains the most salt of any of the profiles used in this study. This probably reflects the quality of water used for irrigation, but this is not certain since data on the water are not available. If a smooth curve were drawn to connect the mid-points of the lines representing EC_e for the horizons in figure 12, the shape of this curve would closely parallel a similar curve drawn for the increments. This fails, however, to show the extreme value for EC_e which comes in the 38- to 40-inch increment. This same increment also has the highest percent total soluble salt, the highest lime equivalent, as shown in figure 18, and the highest pH_5 as shown in figure 6. The general shapes of the curves representing pH, pH_5, T.S.S., EC_e, and lime equivalent are very similar for this profile.

It appears that for all of these soils the EC_e distribution is quite independent of the horizons, i.e., there is no indication that changes in EC_e actually occur at horizon boundaries. In fact, the biggest changes in EC_e seem to come within horizons rather than between them.

Calcium carbonate equivalent

Figures 13 through 18 and tables 13 through 15 show the results obtained for the determination of lime equivalent.

In all of the profiles studied there is a small amount of carbonate in the surface which decreases to zero or nearly zero with increased depth until the zone of lime accumulation is reached. At this point the increase in lime is very rapid as shown by the horizon values. However, by increments the increase, though rapid, is shown to be much less abrupt. In most cases, the horizon value is very nearly the average of the values for the corresponding increments. Looking at the Mendon no. 2 profile shown in table 13 and figure 14 as an example, it would be

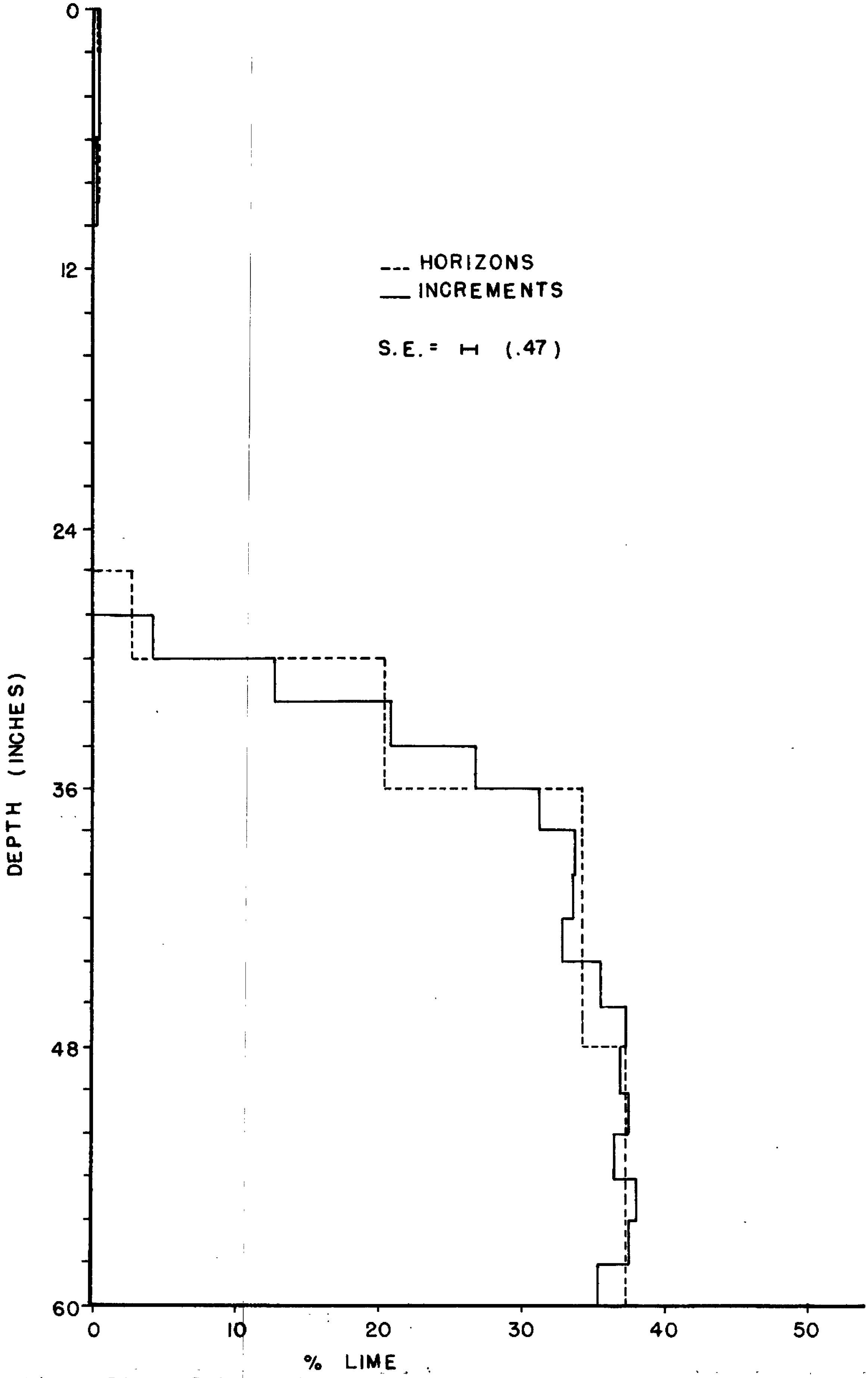


Figure 13. Calcium carbonate equivalent of Mendon profile no. 1 by horizons and by increments

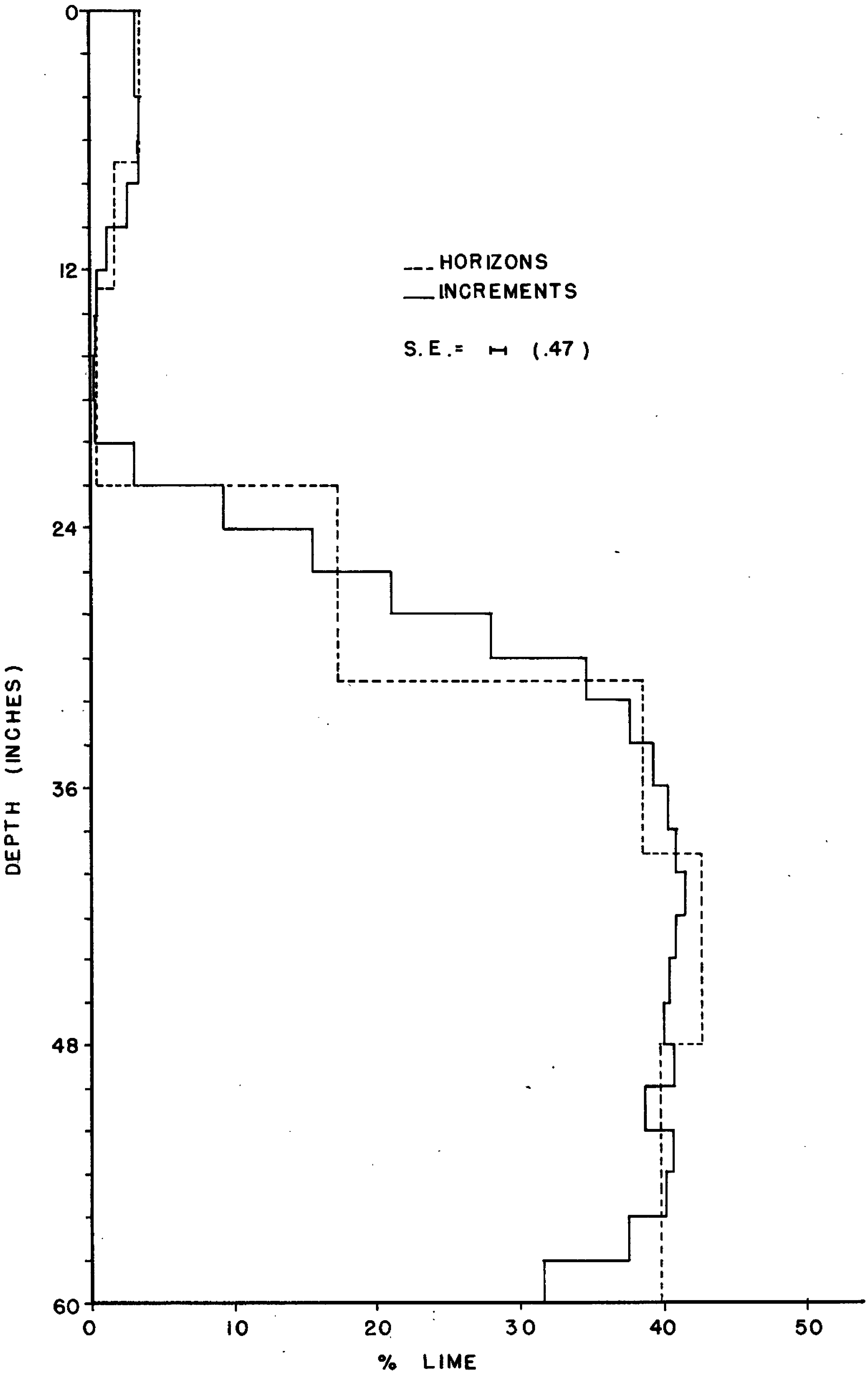


Figure 14. Calcium carbonate equivalent of Mendon profile no. 2 by horizons and by increments

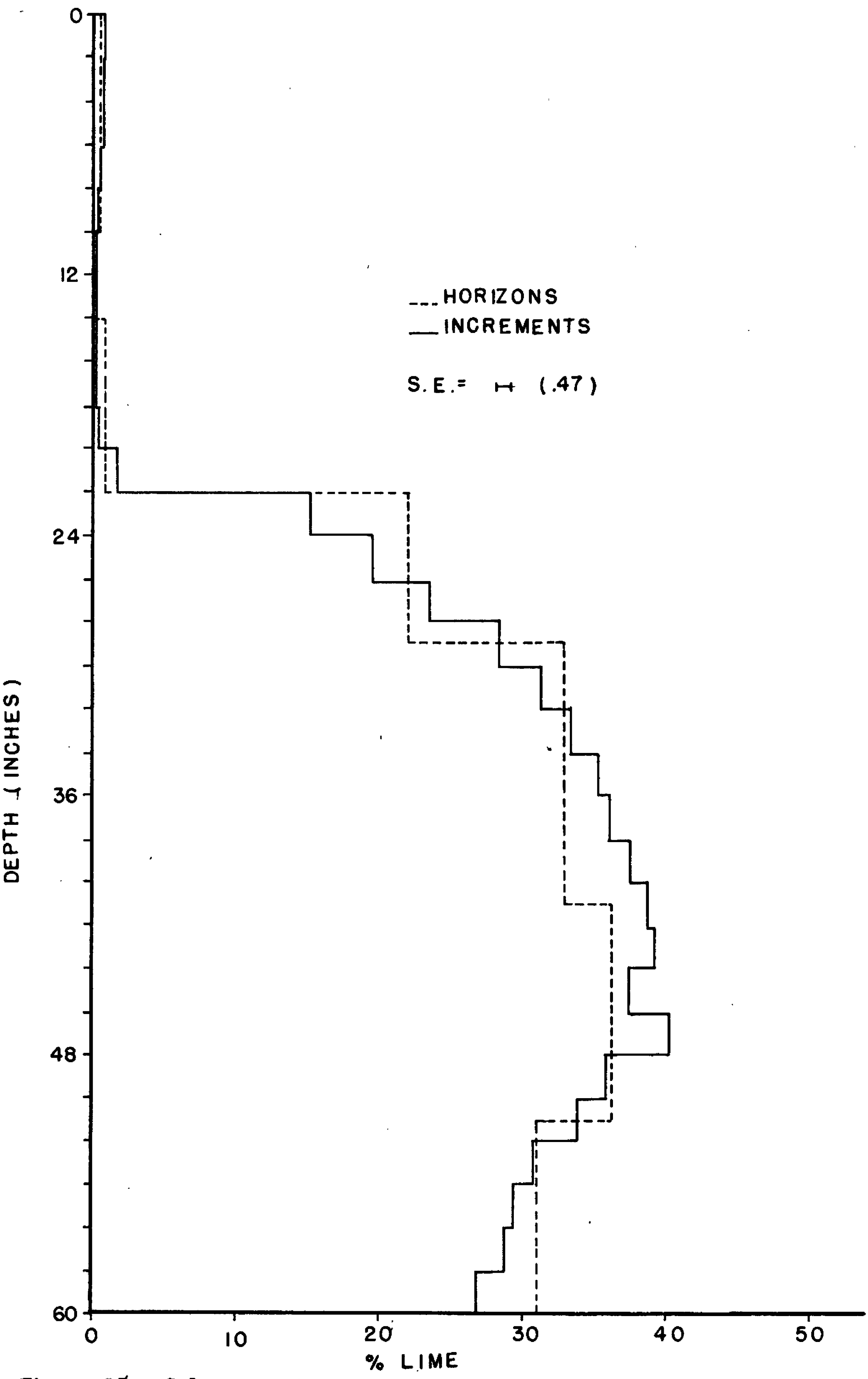


Figure 15. Calcium carbonate equivalent of Mendon profile no. 3 by horizons and by increments

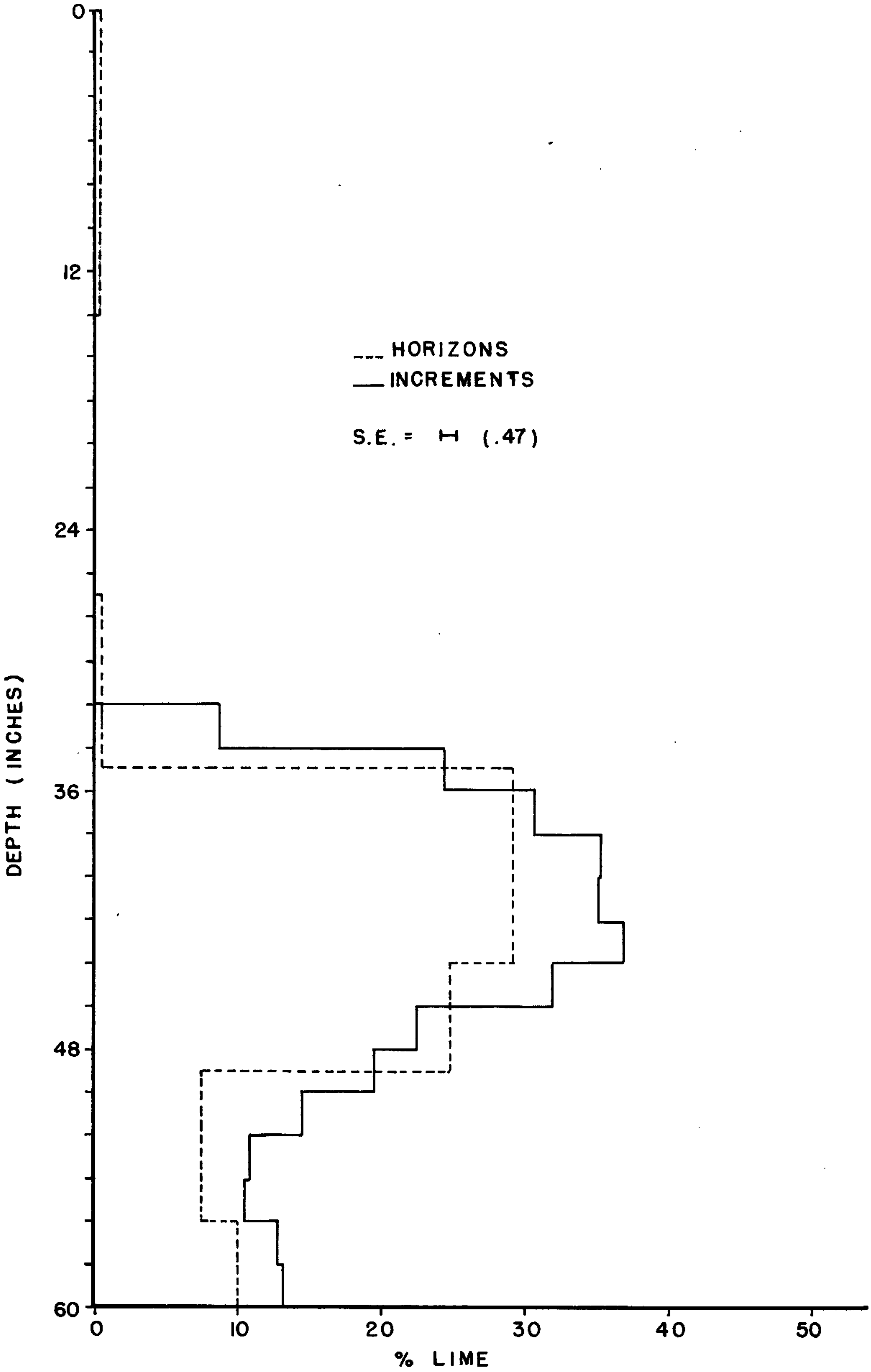


Figure 16. Calcium carbonate equivalent of Parleys profile no. 1 by horizons and by increments.

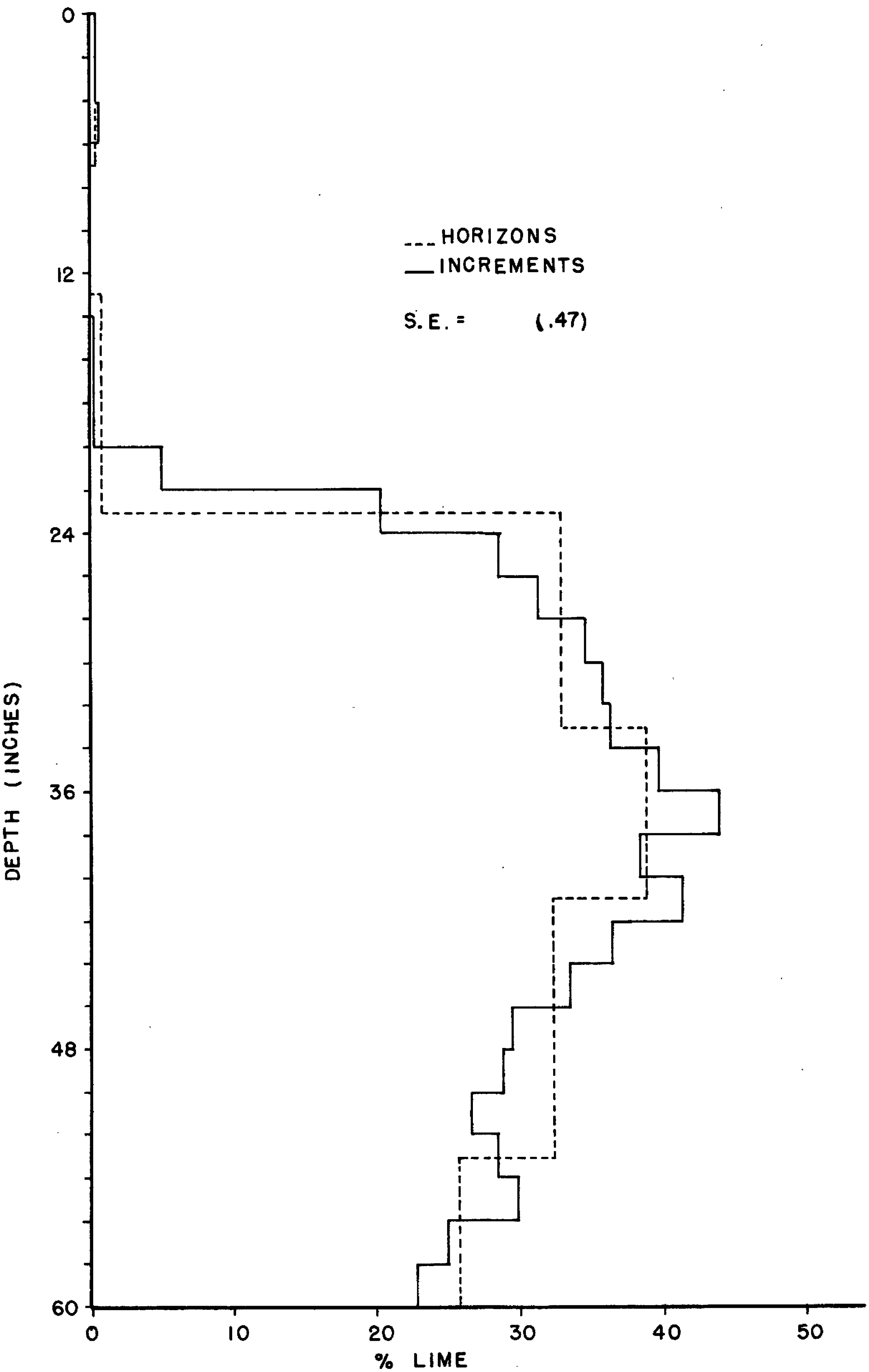


Figure 17. Calcium carbonate equivalent of Parleys profile no. 2 by horizons and by increments

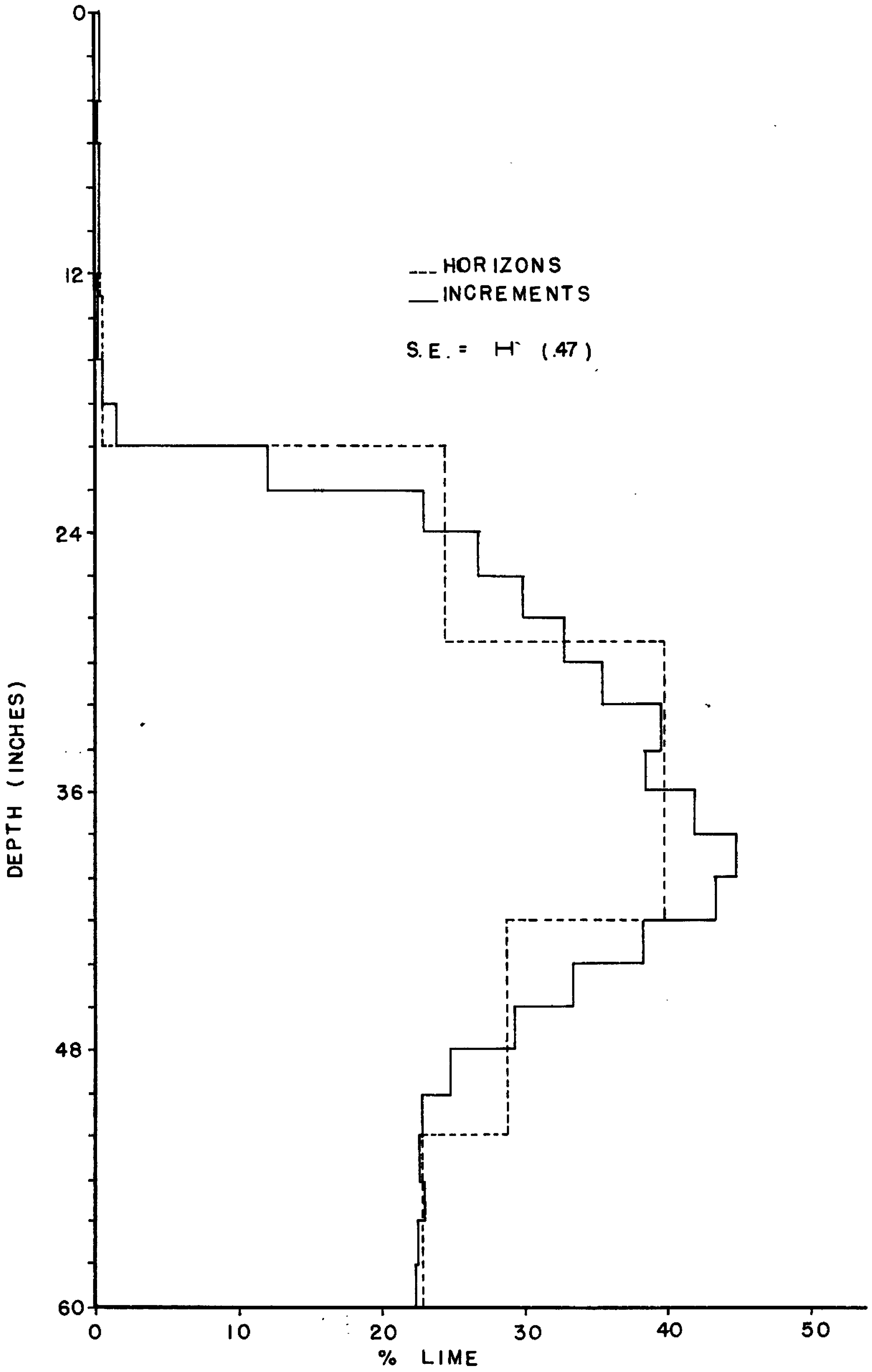


Figure 18. Calcium carbonate equivalent of Parleys profile no. 3 by horizons and by increments

Table 13. Calcium carbonate equivalent of Mendon profile no. 1 and Mendon profile no. 2 by horizons and by increments

Mendon no. 1				Mendon no. 2			
Depth	Horizon	$CaCO_3$ Horizon	$CaCO_3$ Increment	Depth	Horizon	$CaCO_3$ Horizon	$CaCO_3$ Increment
inches		percent	percent	inches		percent	percent
0-2			0.35	0-2			3.1
2-4			0.26	2-4			3.1
4-6	Ap	0.26	0.32	4-6	A_1p	3.6	3.6
6-8			0.16	6-8			3.4
8-10			0.16	8-10			2.5
10-12	B_{21}	0.0	0.0	10-12	A_{12}	1.7	1.0
12-14			0.0	12-14			0.4
14-16			0.0	14-16			0.3
16-18			0.0	16-18	B_2	0.4	0.2
18-20	B_{22}	0.0	0.0	18-20			0.3
20-22			0.0	20-22			3.0
22-24			0.0	22-24			9.2
24-26			0.0	24-26			15.5
26-28	B_{23}	2.6	0.0	26-28	B_2ca	17.2	20.9
28-30			4.1	28-30			28.0
30-32			12.6	30-32			34.5
32-34	B_3ca	20.3	20.8	32-34			37.7
34-36			26.6	34-36			39.3
36-38			31.2	36-38	Cca	38.4	40.2
38-40			33.7	38-40			40.9
40-42	Cca	34.1	33.6	40-42			41.6
42-44			32.7	42-44	Cca	42.5	40.9
44-46			35.6	44-46			40.3
46-48			37.2	46-48			40.0
48-50			36.9	48-50			40.7
50-52			37.3	50-52			38.5
52-54	Cca	37.2	36.3	52-54	Cca	39.8	40.6
54-56			38.0	54-56			40.1
56-58			37.4	56-58			37.5
58-60			35.3	58-60			31.6

Table 14. Calcium carbonate equivalent of Mendon profile no. 3 and Parleys profile no. 1 by horizons and by increments

Mendon no. 3				Parleys no. 1			
Depth	Horizon	$CaCO_3$ Horizon	$CaCO_3$ Increment	Depth	Horizon	$CaCO_3$ Horizon	$CaCO_3$ Increment
inches		percent	percent	inches		percent	percent
0-2	Ap	0.4	0.7	0-2	A_{11}	0.2	0.0
2-4			0.6	2-4			0.0
4-6			0.6	4-6			0.0
6-8			0.4	6-8			0.0
8-10			0.3	8-10	A_{12}	0.2	0.0
10-12	B_1	0.0	0.2	10-12			0.0
12-14			0.2	12-14			0.0
14-16	B_2	0.8	0.2	14-16	B_{21}	0.0	0.0
16-18			0.2	16-18			0.0
18-20			0.3	18-20	B_{21}	0.0	0.0
20-22			1.8	20-22			0.0
22-24	B_2ca	22.0	15.1	22-24			0.0
24-26			19.6	24-26			0.0
26-28			23.5	26-28	B_{22}	0.4	0.0
28-30	Cca	32.8	28.2	28-30			0.0
30-32			30.6	30-32			0.0
32-34			33.2	32-34			8.6
34-36			35.3	34-36	Cca	29.1	24.3
36-38			36.1	36-38			30.5
38-40			37.5	38-40			35.1
40-42	Cca	36.1	38.6	40-42			35.0
42-44			39.1	42-44			36.6
44-46			37.4	44-46	C	24.4	31.9
46-48			40.2	46-48			22.3
48-50			35.9	48-50	C	7.6	19.6
50-52	Cca	31.0	33.9	50-52			14.3
52-54			30.8	52-54			10.9
54-56			29.3	54-56			10.6
56-58			28.8	56-58	C	10.0	12.7
58-60			26.7	58-60			13.1

Table 15. Calcium carbonate equivalent of Parleys profile no. 2 and Parleys profile no. 3 by horizons and by increments

Parleys no. 2				Parleys no. 3			
		$CaCO_3$				$CaCO_3$	
Depth	Horizon	Horizon	Increment	Depth	Horizon	Horizon	Increment
inches		percent	percent	inches		percent	percent
0-2			0.2	0-2			0.2
2-4			0.2	2-4	Ap	0.2	0.2
4-6	Ap	0.2	0.3	4-6			0.1
6-8			0.0	6-8			0.2
8-10			0.0	8-10			0.2
10-12	AB	0.0	0.0	10-12	AB	0.2	0.2
12-14			0.0	12-14			0.1
14-16			0.2	14-16			0.1
16-18			0.2	16-18	B_2	0.4	0.4
18-20	B_2	0.8	0.2	18-20			1.5
20-22			5.0	20-22			12.1
22-24			20.3	22-24			22.9
24-26			28.4	24-26	B_2ca	24.4	26.9
26-28			31.2	26-28			29.9
28-30	B_3ca	32.9	34.3	28-30			32.7
30-32			35.7	30-32			35.3
32-34			36.1	32-34			39.6
34-36			39.7	34-36	Cca_1	39.7	38.3
36-38	Cca_1	38.7	43.8	36-38			41.9
38-40			38.3	38-40			44.7
40-42			41.2	40-42			43.2
42-44			36.3	42-44			38.2
44-46			33.4	44-46			33.3
46-48	Cca_2	32.2	29.3	46-48	Cca_2	28.6	29.3
48-50			28.7	48-50			24.8
50-52			27.4	50-52			22.9
52-54			28.3	52-54			22.7
54-56			29.8	54-56	C	22.8	22.9
56-58	Cca_3	25.8	24.8	56-58			22.4
58-60			22.6	58-60			22.3

assumed from looking at the horizon data that the lime equivalent goes by sudden jumps from less than 1 percent in the B2 horizon (13 to 22 inches) to over 17 percent in the B_2ca horizon (22 to 31 inches) to more than 38 percent in the Cca horizon (31 to 39 inches). It is shown by the increment data, however, that this is not the case. Lime equivalent makes a steady increase throughout these horizons and bears no apparent relationship to the horizons. Some of the profiles do show a fairly large increase in lime by increments which correspond to the horizon boundary at the top of the lime zone. This is to be expected from the fact that the horizon boundary was determined by testing with HCl in the field. Below this level, however, there is apparently no relationship between lime equivalent and horizons.

If a smooth curve were drawn to connect the mid-points of the lines representing the horizon values, this curve would, for most of these profiles, fall very close to a similar curve drawn for the increments.

<u>Organic carbon, total nitrogen, and carbon-nitrogen ratio</u>

The data found in this study for organic carbon and total nitrogen are found in figures 19 through 24 and tables 16 through 21.

In all of the profiles there is a consistent decrease in both carbon and nitrogen by horizons. This is generally true also for the increments. The one exception to this is the Parleys profile no. 2 shown in table 20 and figure 23. Total nitrogen in this profile decreases to a depth of 14 to 16 inches and then increases again to a depth of 20 to 22 inches.

It appears, from looking at the horizon curves in figures 19 through 24, that there is a considerable difference between the carbon

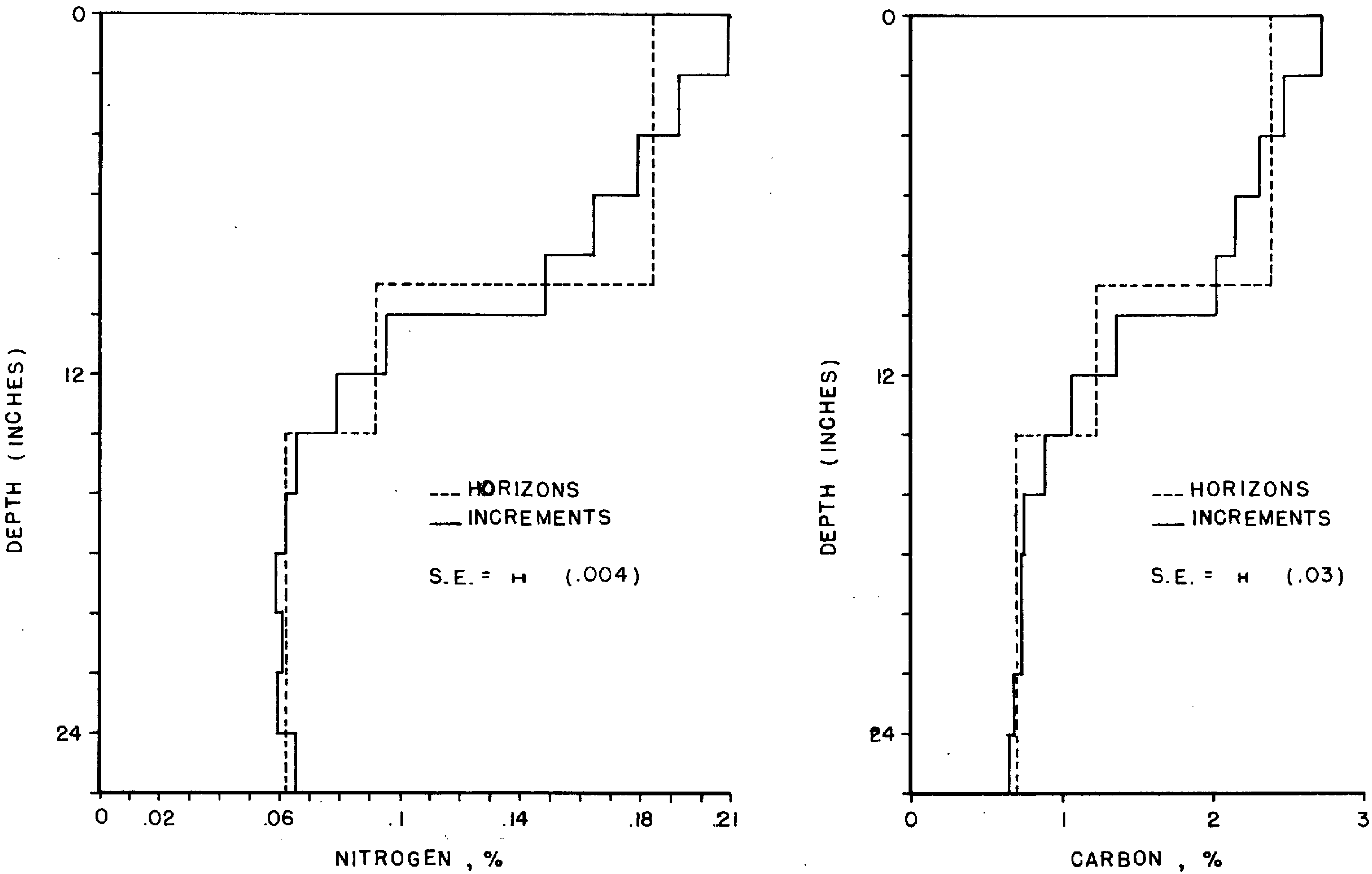


Figure 19. Organic carbon and total nitrogen contents of Mendon profile no. 1 by horizons and by increments

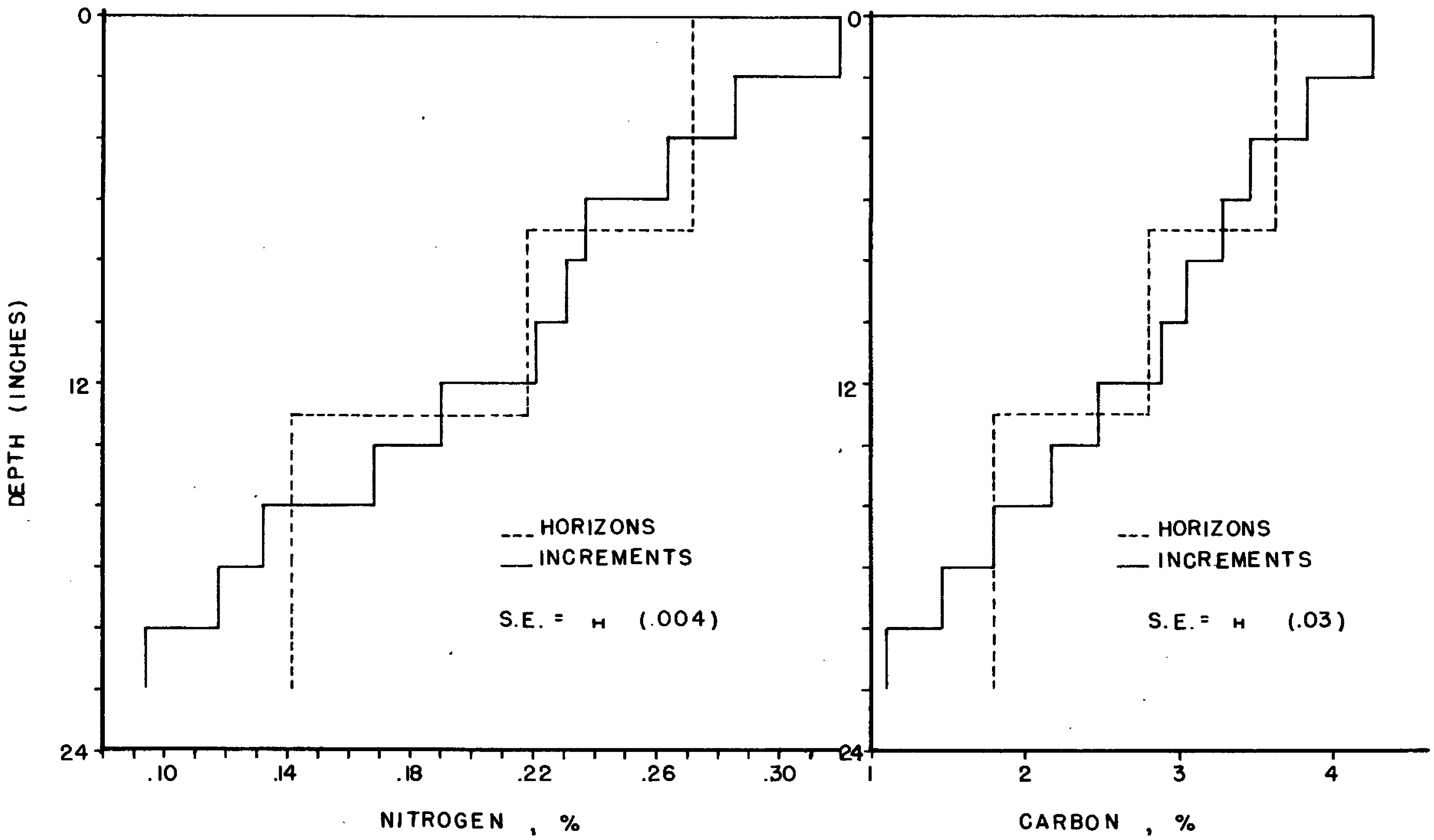


Figure 20. Organic carbon and total nitrogen contents of Mendon profile no. 2 by horizons and by increments

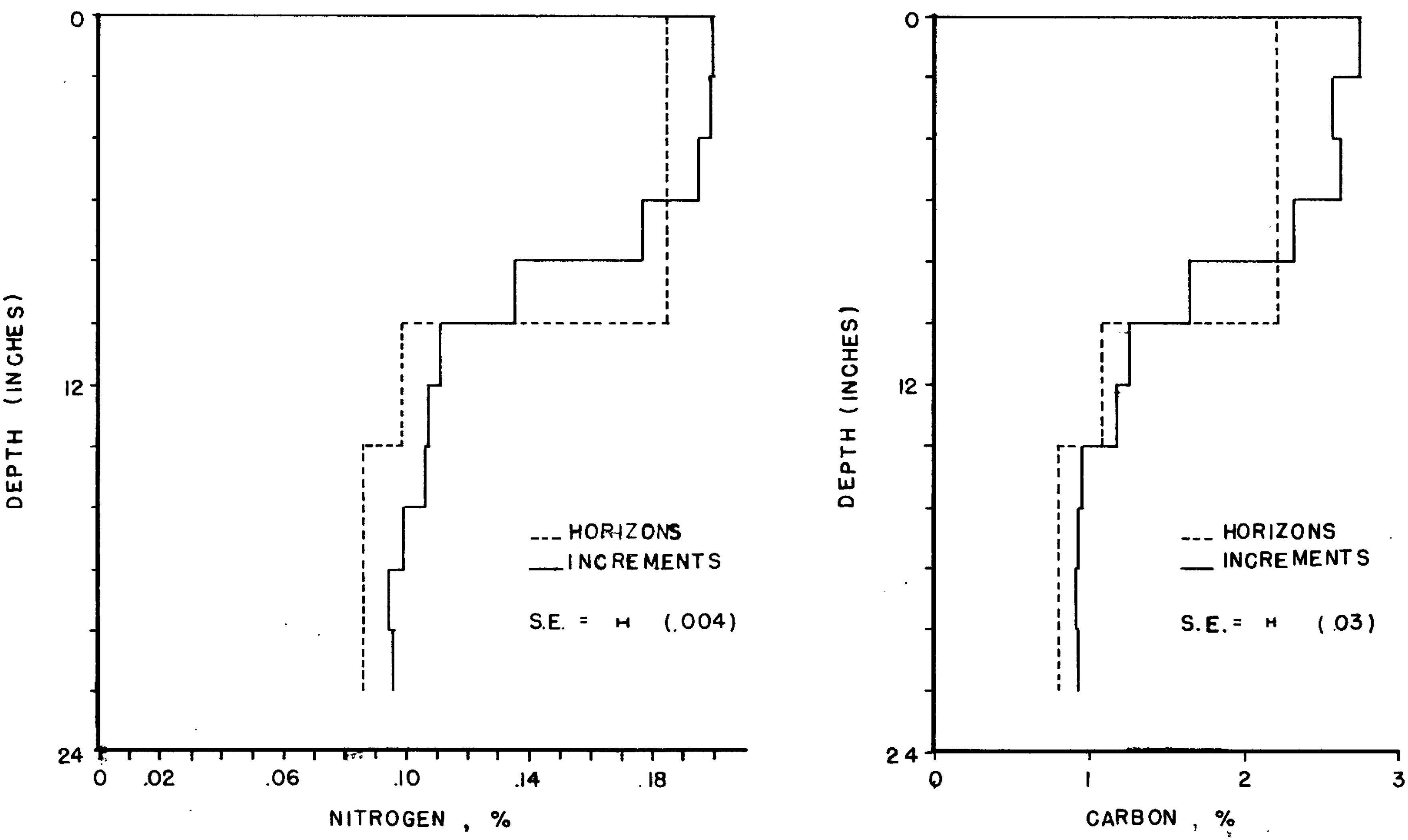


Figure 21. Organic carbon and total nitrogen contents of Mendon profile no. 3 by horizons and by increments

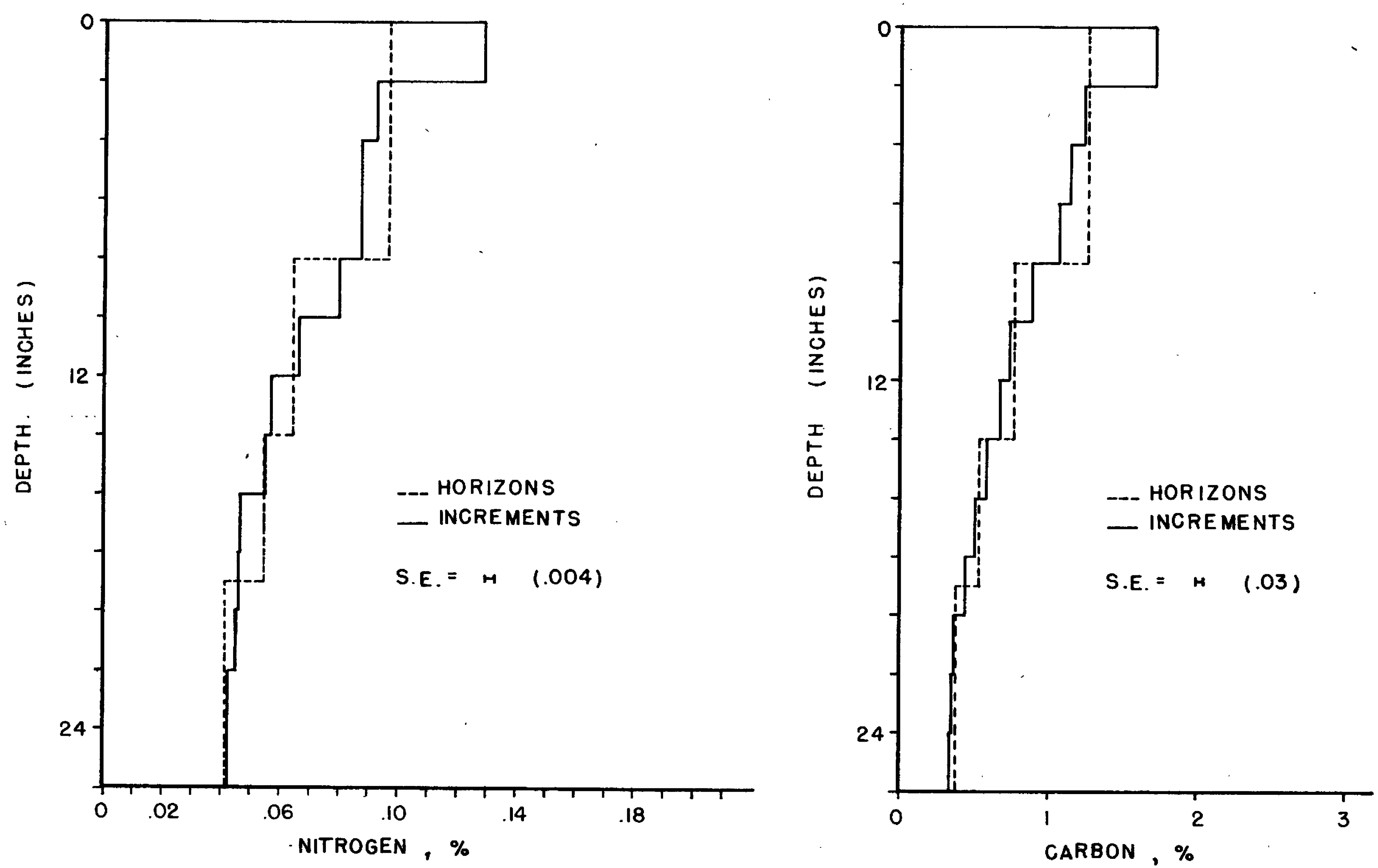
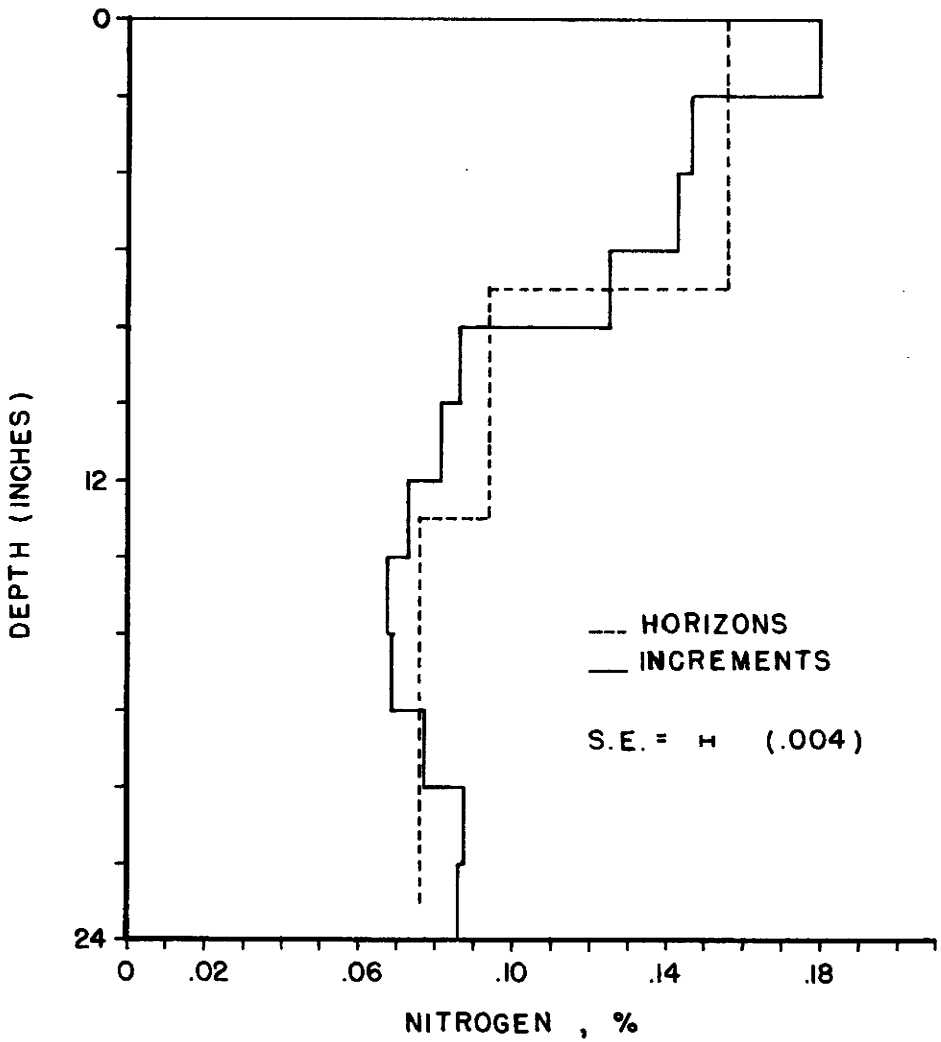


Figure 22. Organic carbon and total nitrogen contents of Parleys profile no. 1 by horizons and by increments



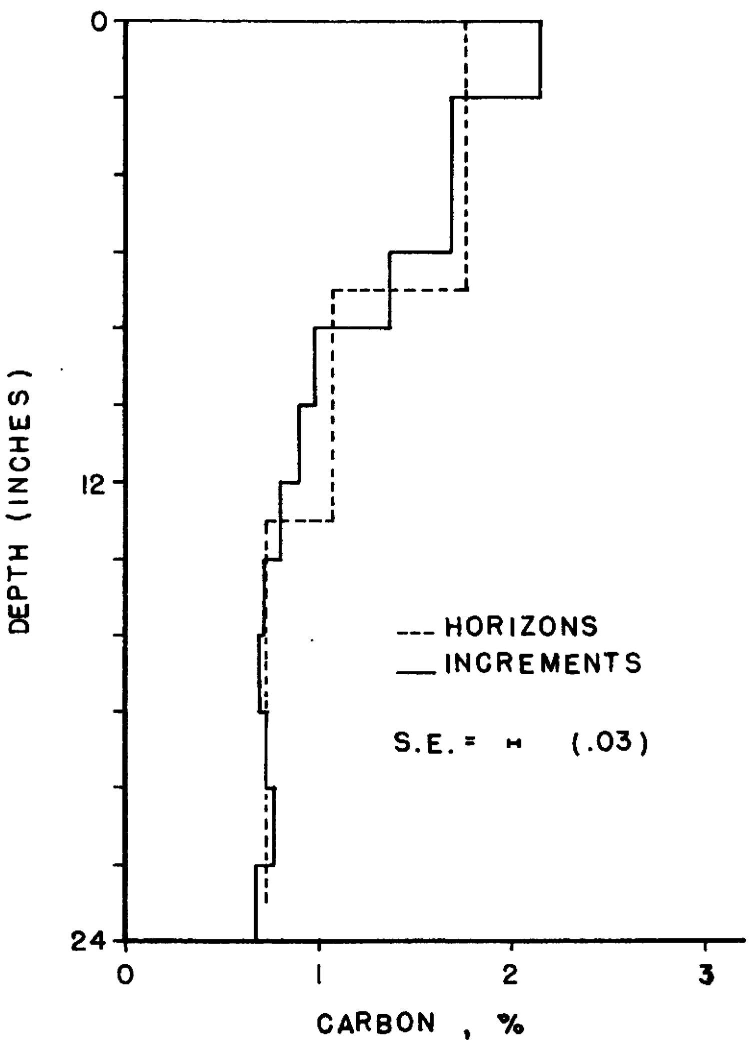


Figure 23. Organic carbon and total nitrogen contents of Parleys profile no. 2 by horizons and by increments

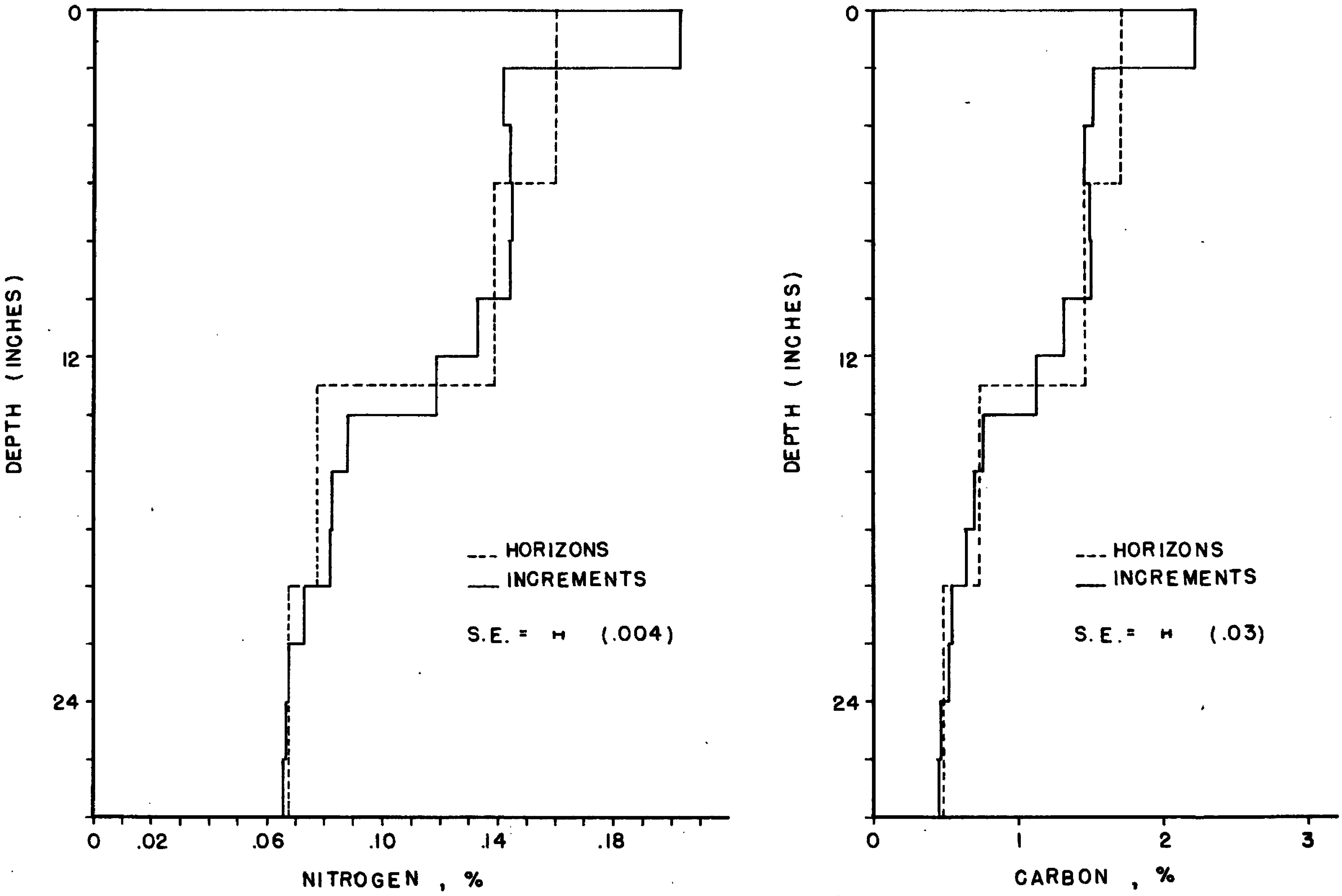


Figure 24. Organic carbon and total nitrogen contents of Parleys profile no. 3 by horizons and by increments

Table 16. Organic carbon and total nitrogen contents and carbon-nitrogen ratio of Mendon profile no. 1 by horizons and by increments

Depth	Horizon	Organic carbon		Total nitrogen		C/N ratio	
		Horizon	Increment	Horizon	Increment	Horizon	Increment
inches		percent	percent	percent	percent		
0-2	Ap	2.38	2.71	0.183	0.209	13.0	13.0
2-4			2.44		0.192		12.7
4-6			2.29		0.179		12.8
6-8			2.16		0.164		13.2
8-10	B_{21}	1.22	2.01	0.091	0.148	13.4	13.6
10-12			1.35		0.095		14.2
12-14			1.05		0.079		13.3
14-16	B_{22}	0.69	0.87	0.062	0.065	11.1	13.4
16-18			0.73		0.062		11.8
18-20			0.72		0.059		12.2
20-22			0.72		0.061		11.8
22-24			0.68		0.059		11.7
24-26			0.63		0.065		9.7

Table 17. Organic carbon and total nitrogen contents and carbon-nitrogen ratio of Mendon profile no. 2 by horizons and by increments

Depth	Horizon	Organic carbon		Total nitrogen		C/N ratio	
		Horizon	Increment	Horizon	Increment	Horizon	Increment
inches		percent	percent	percent	percent	percent	percent
0-2	A_{1p}	3.61	4.25	0.272	0.320	13.3	13.3
2-4			3.82		0.285		13.4
4-6			3.46		0.263		13.2
6-8	A_{12}	2.80	3.28	0.218	0.237	12.8	13.8
8-10			3.03		0.231		13.1
10-12			2.88		0.221		13.0
12-14	B_2	1.80	2.48	0.142	0.190	12.6	13.1
14-16			2.17		0.168		12.9
16-18			1.80		0.132		13.6
18-20			1.45		0.118		12.8
20-22			1.10		0.093		11.8

Table 18. Organic carbon and total nitrogen contents and carbon-nitrogen ratio of Mendon profile no. 3 by horizons and by increments

Depth	Horizon	Organic carbon		Total nitrogen		C/N ratio	
		Horizon	Increment	Horizon	Increment	Horizon	Increment
inches		percent	percent	percent	percent		
0-2			2.77		0.200		13.9
2-4			2.59		0.199		13.0
4-6	Ap	2.22	2.62	0.185	0.195	12.0	13.4
6-8			2.33		0.177		13.1
8-10			1.63		0.135		12.1
10-12	B_1	1.09	1.26	0.099	0.111	11.0	11.4
12-14			1.18		0.107		11.6
14-16			0.96		0.106		11.0
16-18	B_2	0.80	0.93	0.086	0.101	9.3	9.3
18-20			0.91		0.095		9.6
20-22			0.93		0.096		9.7

Table 19. Organic carbon and total nitrogen contents and carbon-nitrogen ratio of Parleys profile no. 1 by horizons and by increments

Depth	Horizon	Organic carbon		Total nitrogen		C/N ratio	
		Horizon	Increment	Horizon	Increment	Horizon	Increment
inches		percent	percent	percent	percent		
0-2		2.18	1.71		0.129		13.3
2-4	A_{11}	1.24	1.22	0.097	0.092	12.8	13.3
4-6			1.14		0.087		13.1
6-8			1.04		0.087		12.0
8-10			0.87		0.080		10.9
10-12	A_{12}	0.76	0.72	0.064	0.066	11.9	10.9
12-14			0.68		0.057		11.9
14-16			0.58		0.055		10.5
16-18	B_{21}	0.52	0.50	0.054	0.046	9.6	10.9
18-20			0.44		0.045		9.8
20-22			0.38		0.044		8.6
22-24	B_{21}	0.39	0.37	0.041	0.042	9.5	8.8
24-26			0.36		0.042		8.6
26-28							

Table 20. Organic carbon and total nitrogen contents and carbon-nitrogen ratio of Parleys profile no. 2 by horizons and by increments

Depth	Horizon	Organic carbon		Total nitrogen		C/N ratio	
		Horizon	Increment	Horizon	Increment	Horizon	Increment
inches		percent	percent	percent	percent		
0-2		3.62	2.14		0.180		11.9
2-4			1.68		0.147		11.4
4-6	Ap	1.76	1.68	0.157	0.143	11.2	11.7
6-8			1.36		0.125		10.9
8-10			0.98		0.087		11.3
10-12	AB	1.06	0.88	0.094	0.082	11.3	10.7
12-14			0.80		0.073		11.0
14-16			0.71		0.068		10.4
16-18			0.69		0.069		10.0
18-20	B_2	0.72	0.72	0.076	0.077	9.5	9.4
20-22			0.77		0.088		8.8
22-24			0.65		0.086		7.6

Table 21. Organic carbon and total nitrogen contents and carbon-nitrogen ratio of Parleys profile no. 3 by horizons and by increments

Depth	Horizon	Organic carbon		Total nitrogen		C/N ratio	
		Horizon	Increment	Horizon	Increment	Horizon	Increment
inches		percent	percent	percent	percent		
0-2	2.94		2.21		0.204		10.8
2-4	Ap	1.71	1.51	0.160	0.142	10.7	10.6
4-6			1.44		0.145		9.9
6-8			1.47		0.146		10.1
8-10	AB	1.43	1.48	0.139	0.145	10.3	10.2
10-12			1.31		0.133		9.8
12-14			1.11		0.119		9.3
14-16			0.74		0.088		8.4
16-18	B_2	0.71	0.67	0.078	0.083	9.1	8.1
18-20			0.62		0.082		7.6
20-22			0.53		0.073		7.3
22-24			0.51		0.068		7.5
24-26	B_2ca	0.48	0.47	0.068	0.067	7.1	7.0
26-28			0.45		0.066		6.8
28-30							

and nitrogen content in successive horizons. In most cases, however, the increment curves show this conclusion to be erroneous. The best example of this is the Mendon no. 2 profile shown in figure 20. These curves indicate no relationship between horizons and carbon or nitrogen content. In contrast to this, however, is Mendon profile no. 1 shown in figure 19. These curves show that the actual carbon and nitrogen content decreases at approximately the boundary between the two top horizons. Perhaps the decrease would exactly coincide with the horizon boundary if the increments had been chosen so as to fall on that boundary. Parleys profiles no. 1 and no. 3 show similar results but to a less marked degree. Mendon profile no. 3 in figure 21 appears, on the basis of carbon and nitrogen content, to have the horizon boundary set two inches too deep in the profile.

In all of these profiles except Mendon profile no. 3 there is a strong suggestion from the increment data that a horizon boundary should be set at the 2-inch depth. This further indicates the lack of relationship between horizons and carbon and nitrogen content of the soil.

A smooth curve drawn to connect the mid-points of the lines representing horizon values for both organic carbon and total nitrogen would, for all of the profiles studied, very nearly coincide with a similar curve drawn for the increments.

C/N ratios are shown in tables 16 through 21 but no graphs were drawn for them. It was felt that this would have little value because the C/N ratio absorbs all of the error for both organic carbon and total nitrogen.

DISCUSSION

Since 1920 when Marbut first presented a scheme for soil classification, samples for classification purposes have been taken by horizons and the data have been interpreted on this basis. There have since been some changes suggested in the classification criteria, as reported by Whiteside (21), but the changes are minor as they apply to the horizons. The differentiation of horizons is made, with the exception of lime zones, from visible color, textural, and structural changes. Chemical composition is used in the classification only as it occurs within a horizon without regard to actual occurrence in the profile. However, as Robinson (16) pointed out, laboratory data become more important as soil classification becomes more minute. For this reason this study was made to determine if the soil horizon had a significance beyond the properties which are observed in the field.

There was considerable variation found with depth in pH and pH_5 of samples taken both by horizons and by increments. This variability may be attributed to several causes. Fireman and Wadleigh (6) reported that pH was affected by exchangeable sodium, other adsorbed ions, soil-water ratio, texture, CO_2 pressure, insoluble carbonates, gypsum, soluble salts, organic matter, and clay type. According to Buehrer and Williams (4) the pH of a calcareous soil is determined by the calcium carbonate-bicarbonate buffer system of the soil. Huberty and Haas (8) found that pH varied with method of drying, length of drying time, storage container, dilution, and irrigation practices. They also found pH variations from successive mixings of the same soil sample. This is a likely cause of the small fluctuations between the pH values of successive increments found in this study.

With all of the factors which affect pH, there is some question as to what is being determined with a pH measurement. For this reason, perhaps, the specific pH of a soil is not as important in its classification as is the general range into which it falls, i.e., strongly, moderately, or weakly acid; neutral; or strongly, moderately, or weakly alkaline. It is doubtful, from the data found in this study, that pH or pH_5 would be helpful in differentiating horizons in these soils. Since only broad interpretations of pH can be made, either horizon or increment pH measurements appear to be adequate. Work by Mehlich (11), however, suggests that the relationship between base unsaturation and pH may be helpful in determining the type of mineral in the soil.

There is a great deal of difference in the shapes of the curves for T.S.S. and EC_e for all of the profiles included in this study, even though they should both give an estimate of the salt content of the soil. Reitemeier and Wilcox (15) concluded that EC_e was the better measure of salt because it is correlated better to crop response. They reported that the inaccuracy of the paste conductivity measurement came from the lack of a cell constant in the soils cup, variations in saturation percentage, variations in soil salinity, and conductivity of soil minerals.

EC_e is useful in soil characterization in evaluating drainage conditions but the soils used in this study are all low in salt and it appears that the salt has not affected their development.

There is no apparent relationship between either T.S.S. or EC_e and horizons or horizon boundaries in these soils. Samples of these soils, then, may be taken either by horizons or by increments to show salt distribution within the profile.

Close agreement was found between the lime distribution by horizons and by increments. This was to be expected at the top of the lime zone because the horizons at that point were differentiated by the presence or absence of strong effervescence with acid. The identification of the horizons below this, however, were based on textural and structural changes except where an arbitrary division was made in the C or the Cca horizon.

Some work has been reported which indicates that lime distribution may be related to clay distribution of the soil. Redmond (14) reported that for most of the soils which he analyzed, the horizons which had the highest percentage clay also had the highest lime content. It would seem, then, that horizon differentiation which takes structure and texture into account should bear some relationship to the lime distribution. While particle size distribution was not included in this study, such a relationship may be indicated in the data for the soils studied. The best example of this is Parleys profile no. 1 shown in figure 16. In this profile the lime decreased sharply in the C horizon where the texture changed from silty clay loam to loam to sandy loam. It is also seen in Mendon profile no. 3 where the lime decreased as the texture went from heavy silty clay loam to silty clay loam, in Parleys profile no. 2 where lime decreased as the texture changed from silty clay loam to light silty clay loam, and in Parleys profile no. 3 where lime decreased as texture changed from silty clay loam to heavy silt loam. In Mendon profiles no. 1 and 2 neither lime content nor texture change appreciably below the B horizon.

Despite this apparent relationship, there is no indication from the data that changes in lime content coincide with horizon boundaries. Even the boundaries at the tops of the lime zones are not sharp as the horizon data indicate. It is to be expected that 2-inch increments would present a more accurate picture of lime distribution than would the horizons. However, if only the data for the 2-inch increments were availabke, it would be extremely difficult to locate the horizon boundaries. The tops of the lime horizons could be placed quite accurately, and, in some cases, the bottoms of the lime horizons could be determined. Between these two points, however, horizon differentiation based on lime content would be virtually impossible. In addition to this, horizons, no matter how they are determined, tend to obscure the actual distribution of lime in the profile. Suppose, for example, an horizon were placed so that it extended from the top of the lime zone to the center of the lime bulge. The amount of lime measured on that horizon would be approximately intermediate between the actual amounts of lime at the extreme ends of the horizon. The same thing would be found on the underlying horizon and the effect would be to miss the actual lime bulge completely. In addition to this, since the amount of lime measured on the horizon would represent only the mid-point of that horizon, there would be no way of knowing whether lime in that horizon was increasing, decreasing, or was distributed uniformly. The same arguments could be applied to an horizon chosen so as to include the center of the lime bulge. In this case the location of the lime bulge could be seen but the extent of the lime bulge would still be obscured. This same thing would be true, of course, for increments similar in thickness to the horizon samples.

Organic carbon and total nitrogen also show a good agreement between the distribution by horizons and by increments. However, any indications that changes in the content of either organic carbon or total nitrogen occur at horizon boundaries are very slight and are not conclusive since such indications are not present in all of the profiles of each series. In three of the profiles the strongest indications of an horizon is at the 2-inch depth. This was not discernible in the field.

Future work in this field should attempt to show more precisely what the relationship is between the chemical properties and the soil horizon boundaries. This could be done by sampling the area on each side of an horizon boundary by smaller increments than were used in the present study, say one-half inch. This study should include particle size distribution so that changes in chemical properties could be correlated to changes in texture. A study similar to the present one should also be made using increments of from six to twelve inches, which would be more practical for routine sampling. This type of study should also be extended to other soils and for other chemical properties. If it becomes apparent that the type of results found in this study could also be related and applied to other soils and for other chemical properties, then the sampling of soils for characterization could be greatly simplified by simply taking increments.

In addition to the advantage of increased ease of sampling, increment sampling presents a possibility of applying statistical methods to soil classification.[1] A function could be written to describe the curve for each of the characteristics which helps to describe a soil. Such

1. Suggested by Rex Hurst, Head of the Department of Applied Statistics, Utah State University, in private communication.

a function has been written for the distribution of lime equivalent in Mendon profile no. 1. This curve (figure 13) can be represented by a fifth power equation of the form:

$$Y = a + bx + cx^2 + Dx^3 + Ex^4 + Fx^5$$

where Y is percent $CaCO_3$ at depth x. By a process of curve fitting with orthogonal polynomials the x values can then be transformed to give the equation:

$$Y = A_0 + A_1\xi_1 + A_2\xi_2 + A_3\xi_3 + A_4\xi_4 + A_5\xi_5 .$$

In this form the numerical values of the coefficients can be calculated. For this curve they were found to be: $A_0 = 16.356$, $A_1 = 0.8847$, $A_2 = 0.02116$, $A_3 = -0.005966$, $A_4 = -0.0001526$, and $A_5 = 0.0002747$. Solving the equation for each of the thirty increments in the profile gave the following results:

Observed $CaCO_3$ percent	Expected $CaCO_3$ from equation percent	Observed $CaCO_3$ percent	Expected $CaCO_3$ from equation percent
0.4	-2.399	12.6	14.136
0.3	1.301	20.8	18.355
0.3	2.647	26.6	22.525
0.2	2.446	31.2	26.474
0.2	1.343	33.7	30.023
0.0	-0.113	33.6	33.031
0.0	-1.501	32.7	35.386
0.0	-2.522	35.6	37.023
0.0	-2.938	37.2	37.931
0.0	-2.619	36.9	38.145
0.0	-1.506	37.3	37.808
0.0	0.397	36.3	37.120
0.0	3.038	38.0	36.370
0.0	6.304	37.4	35.975
4.1	10.054	35.3	36.434

It is obvious that the curve does not fit the data exactly. A perfect fit would require an equation of a much higher power. If the increment depths had been 10 inches instead of 2 inches, the number of increments would have been reduced to six and a fifth or possibly a fourth power equation would produce a curve which would fit the data very well. The fewer increments would also greatly simplify the calculation of the coefficients of the equation.

The coefficients of such an equation are completely independent of each other and comparable coefficients for different soils could be compared in any way desired. One or more of the coefficients should show the characteristic or characteristics of the curve which differentiate one soil from another with respect to the distribution of a particular chemical constituent. Since comparisons between profiles would be made on the distribution curves instead of the actual content of the soil, these functions would eliminate the difficulty of comparing profiles which do not have the same horizons or in which the horizons occur at different depths.

Classification on this basis could be an objective process based on pre-set limits for the coefficients of the discriminant functions of each series.

The writing of functions of this type is much easier if the data are based on even depth increments instead of the uneven horizon depths.

CONCLUSIONS

It is shown in this study that the horizons of these soils have little or no significance beyond what is observed in the field insofar as these chemical properties are concerned. In some instances there is an indication, as shown by sharp breaks in the curves, that a relationship may exist between the horizon boundary and the distribution of a particular chemical property. However, the indications of this relationship are slight and are not supported by indications of similar relationships with the other chemical properties measured on the same soils. In other words, while the distribution of one chemical property, such as organic carbon, might indicate a horizon boundary at a certain depth, other chemical properties either indicate the boundary to be at a different depth or else give no indication of a boundary at all.

The distributions of the chemical properties used in this study are seen to follow gradients in these soils. Because of this, any separations within these profiles used in sampling for these laboratory analyses are arbitrary. Thus the method of sampling these soils may depend on the information desired. If only horizon values are important then horizon samples are sufficient, but if data are desired on distribution of soil properties within these profiles the horizon samples are not adequate for lime or for organic matter.

The profiles used in this study were chosen by field observation and were to represent, as nearly as possible, the modal concepts of the two series. The fact that in each of the two series there was one profile that did not conform to this modal concept illustrates the difficulty of correlating laboratory and field data by observation and of selecting in the field soils that will show similar characteristics in the laboratory. It also serves to illustrate a statement by Whiteside (21) that:

> ...it seems more correct...to say that soil individuals should be defined in terms of the ranges of their differentiating properties rather than by a modal individual...

SUMMARY

A sampling study was made to determine the relationship between soil horizons and the distribution of various chemical properties. Three sites each were selected for the Mendon series and the Parleys series and the soil at each site was sampled by horizons and by 2-inch increments. These samples were then analyzed for pH, pH_5, total soluble salts, saturation extract conductivity, $CaCO_3$ equivalent, organic carbon, and total nitrogen. The results for each were plotted, showing both the horizon and increment data for a profile on the same graph so that direct comparisons could be made between the two distribution curves.

There was no indication from the results obtained that these laboratory data on these soils would help to differentiate horizons except at the top of the lime zone. The pH and pH_5 results were inconsistent and either method of sampling appeared to give an adequate measure of the pH profile. The distribution of salts when measured as total soluble salts appeared different from the distribution when measured as saturation extract conductivity. Neither analytical method indicated that horizon samples furnished a better picture of the salt distribution than did the increment samples. For the other determinations there were no indications of a consistent relationship between the chemical properties and the horizons except at the top of the lime zone. Horizon and increment samples both presented the same picture of the distribution of these chemical properties.

There was no clear indication of any relationships existing between the various chemical properties and the horizons or horizon boundaries except at the top of the lime zone. The data suggest that to obtain information on these soils concerning the distribution profiles of these soil properties, a number of uniform depth increments equal to the number of horizons in the profile would have been as adequate as the horizon samples.

Advantages of increment sampling are increased ease of sampling from elimination of the need to separate horizons precisely, and the possibility which it provides of applying statistical methods to soil classification.

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APPENDIX

MENDON SERIES

The Mendon soils are Chernozem soils located in Northern Utah and Southern Idaho on old lake terraces which probably have had a recent over-wash of fine-textured materials over stratified, calcareous clayey lake deposits. Slopes usually range from 1 to 3 percent. The mean annual precipitation is about 16 inches and the mean annual temperature is about 47° F. Summers are relatively dry with most of the moisture coming from snow in the winter and rain in the spring.

Mendon Silt Loam—Profile no. 1

This profile was taken in an alfalfa field in the SE¼, Sec. 32, T 12N, R 1W, about 2 miles north of Mendon, Cache County, Utah.

Profile Description

Horizon	Depth inches	
Ap	0-9	Dark grayish brown (2.5Y 4/2) silt loam, black (10YR 2/1) when moist; weak coarse platy breaking to weak medium to fine platy; slightly hard, dry; friable, moist; slightly sticky and plastic, wet; non-effervescent; paste pH 7.7; clear smooth boundary.
B_{21}	9-14	Grayish brown (2.5Y 5/2) silty clay loam, very dark gray (10YR 3/1) when moist; structureless to weak angular blocky breaking to moderate fine angular blocky; thin continuous clay-skins; hard, dry; firm, moist; sticky and plastic, wet; non-effervescent; paste pH 7.5; clear smooth boundary.
B_{22}	14-26	Light grayish brown (2.5Y 6/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate medium prismatic breaking to moderate medium angular blocky; moderate continuous clay-skins; very hard, dry; firm, moist; sticky and very plastic, wet; non-effervescent; paste pH 7.5; gradual smooth boundary.
B_{23}	26-30	Light grayish brown (2.5Y 6/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak to moderate medium subangular blocky breaking to weak to moderate fine subangular blocky; thin patchy clay-skins; hard, dry; firm, moist; sticky and plastic, wet; non-effervescent; paste pH 7.3; gradual smooth boundary.
$B_{3}ca$	30-36	Light grayish brown (2.5Y 6/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak coarse platy breaking to weak medium angular blocky; hard, dry; firm, moist; sticky and plastic, wet; strongly effervescent; paste pH 7.9; clear smooth boundary.

Cca_1	36-48	Light grayish (2.5Y 7/2) light silty clay loam, dark brown (10YR 4/3) when moist; massive; hard, dry; firm, moist; sticky and plastic, wet; violently effervescent; paste pH 8.0; gradual smooth boundary.
Cca_2	48-60	Do. Paste pH 8.1.

X Mendon Silty Clay Loam—Profile no. 2

This profile was taken in an alfalfa field in the SW¼, NW¼, Sec. 2, T 14N, R 1E, about 1 mile south of Richmond, Cache County, Utah.

Profile Description

Horizon	Depth inches	
A_{1p}	0-7	Very dark grayish brown (2.5Y 3/2) light silty clay loam, black (10YR 2/1) when moist; weak coarse platy breaking to moderate medium granular; hard, dry; friable, moist; sticky and plastic, wet; slightly effervescent; paste pH 7.8.
A_{12}	7-13	Dark grayish brown (2.5Y 4/2) silty clay loam, black (10YR 2/1) when moist; moderate fine angular blocky; very hard, dry; firm, moist; sticky and plastic, wet; slightly effervescent; paste pH 7.7.
B_2	13-22	Dark grayish brown (2.5Y 4/2) heavy silty clay loam, very dark gray (10YR 3/1) when moist; moderate medium prismatic breaking to moderate medium subangular blocky; very hard, dry; firm, moist; sticky and very plastic, wet; non-effervescent; paste pH 7.5.
$B_{2}ca$	22-31	Light brownish gray (2.5Y 6/2) silty clay loam, light brownish gray (10YR 6/2) when moist; moderate medium prismatic breaking to moderate medium subangular blocky; very hard, dry; firm moist; sticky and plastic, wet; violently effervescent; paste pH 7.5.
Cca	31-39	Light gray (2.5Y 7/2) silty clay loam, light gray (10YR 7/2) when moist; few medium distinct reddish brown mottles; massive; hard, dry; firm, moist; sticky and plastic, wet; violently effervescent; paste pH 8.0.
C	39-48	Light gray (2.5Y 7/2) silty clay loam, light gray (10YR 7/2) when moist; few medium distinct reddish brown mottles; massive; hard, dry; firm, moist; sticky and plastic when wet; violently effervescent; paste pH 7.9.
C	48-60	Do. Paste pH 8.2.

Mendon Silty Clay Loam—Profile no. 3

This profile was taken in a corn field in the NE¼, SW¼, Sec. 5, T 1N, R 1W, about 1 mile north of Mendon, Cache County, Utah.

Profile Description

Horizon	Depth inches	
Ap	0-10	Dark grayish brown (2.5Y 4/2) light silty clay loam, black (10YR 2/1) when moist; weak coarse platy breaking to moderate medium granular; slightly hard, dry; friable, moist; sticky and plastic, wet; many fine roots; non-effervescent; paste pH 7.7.
B_1	10-14	Grayish brown (2.5Y 5/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak medium prismatic breaking to weak fine angular blocky; hard, dry; firm, moist; sticky and plastic, wet; many fine roots; non-effervescent; paste pH 7.4.
B_2	14-22	Dark grayish brown (2.5Y 4/2) heavy silty clay loam, dark brown (10YR 3/3) when moist; weak to moderate prismatic breaking to moderate medium subangular blocky; very hard, dry; firm, moist; sticky and very plastic, wet; common fine roots; non-effervescent; paste pH 7.5.
B_{2ca}	22-29	Light brownish gray (10YR 6/2) heavy silty clay loam, brown or dark brown (10YR 4/3) when moist; weak to moderate prismatic breaking to moderate medium subangular blocky; very hard, dry; firm, moist; sticky and very plastic, wet; violently effervescent; paste pH 7.8.
Cca	29-41	Pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; massive; hard, dry; firm, moist; sticky and plastic, wet; violently effervescent; paste pH 7.9.
C	41-51	Very pale brown (10YR 7/4) silty clay loam, brown (10YR 5/3) when moist; massive; hard, dry; firm, moist; sticky and plastic, wet; violently effervescent; paste pH 7.6.
C	51-60	Do. Paste pH 8.1.

PARLEYS SERIES

The Parleys soils are well-drained Chestnut soils developed in mixed lake sediments found on old lake terraces. They occur at elevations of about 4200 to 4500 feet, usually on slopes of 1 to 3 percent, in a climate which has a mean annual temperature of about 52° F. and an average annual precipitation of 16 to 20 inches with relatively dry summers and with winter and spring being the wettest seasons.

Parleys Silt Loam—Profile no. 1

This profile was taken from a highway right-of-way in an area of cheat grass and gum weed across a fence from a grain field in the SW¼, Sec. 15, T 5N, R 1W, southeast of Ogden, Weber County, Utah.

Profile Description

Horizon	Depth inches	
A_{11}	0-8	Dark grayish brown (10YR 4/2) silt loam, very dark gray (10YR 3/1) when moist; weak to moderate medium to coarse platy breaking to weak fine granular; hard, dry; friable, moist; nonsticky and slightly plastic, wet; non-effervescent; paste pH 7.0; clear smooth boundary.
A_{12}	8-14	Gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) when moist; weak coarse to medium platy breaking to weak fine subangular blocky; hard, dry; friable, moist; nonsticky and slightly plastic, wet; non-effervescent; paste pH 6.9; clear smooth boundary.
B_{21}	14-19	Grayish brown (10YR 5/2) heavy silt loam, dark brown (10YR 3/3) when moist; moderate medium subangular blocky breaking to weak fine subangular blocky; hard, dry; friable, moist; slightly sticky and plastic, wet; non-effervescent; paste pH 7.0; clear smooth boundary.
B_{21}	19-27	Do. Paste pH 7.1.
B_{22}	27-35	Yellowish brown (10YR 5/4) heavy silt loam, brown or dark brown (7.5YR 4/4) when moist; weak medium prismatic breaking to moderate medium subangular blocky; thin patchy clay-skins; very hard, dry; firm, moist; sticky and plastic, wet; non-effervescent; paste pH 7.2; abrupt smooth boundary.
C_{ca}	35-44	Light yellowish brown (10YR 6/4) heavy silt loam, brown (10YR 5/3) when moist; massive; hard, dry; friable, moist; non-sticky and slightly plastic, wet; violently effervescent; paste pH 7.8; abrupt smooth boundary.

C	44-49	Light yellowish brown (10YR6/4) loam, brown (10YR 5/3) when moist; many medium prominent mottles; massive; slightly hard, dry; friable, moist; nonsticky and non-plastic, wet; strongly effervescent; paste pH 7.9; abrupt smooth boundary.
C	49-56	Light yellowish brown (10YR 6/4) light fine sandy loam, brown or dark brown (10YR 4/3) when moist; common medium distinct yellowish-brown mottles; massive; loose, dry and moist; non-sticky and non-plastic, wet; strongly effervescent; paste pH 8.2.
C	56-60	Light yellowish brown (10YR 6/4) very fine sandy loam, brown or dark brown (10YR 4/3) when moist; massive; slightly hard to soft, dry; very friable, moist; non-sticky and non-plastic, wet; strongly effervescent; paste pH 8.2.

Parleys Silt Loam—Profile no. 2

This profile was taken in an alfalfa field in the SW¼, Sec. 34, T 7N, R 1W, east of North Ogden, Weber County, Utah.

Profile Description

Horizon	Depth inches	
Ap	0-7	Dark grayish brown (10YR 4/2) heavy silt loam, very dark gray (10YR 3/1) when moist; weak to moderate medium and fine granular; slightly hard, dry; friable, moist; slightly sticky and slightly plastic, wet; non-effervescent; paste pH 6.9.
AB	7-13	Grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak medium sub-angular blocky breaking to moderate fine subangular blocky; hard, dry; firm, moist; sticky and plastic, wet; non-effervescent; paste pH 6.7.
B_2	13-23	Brown (10YR 5/3) silty clay to dark yellowish brown (10YR 3/4) when moist; weak to moderate prismatic breaking to moderate medium subangular blocky; thin patchy clay-skins; very hard, dry; very hard, dry; very firm, moist; very sticky and very plastic, wet; non-effervescent; paste pH 7.1.
B_{3ca}	23-33	Light yellowish brown (10YR 6/4) silty clay loam, brown or dark brown (10YR 4/3) when moist; weak medium prismatic breaking to weak medium subangular blocky; hard, dry; firm to friable, moist; slightly sticky and plastic, wet; violently effervescent; paste pH 7.6.
C_{ca1}	33-41	Pale brown (10YR 6/3) light silty clay loam, brown or dark brown (10YR 4/3) when moist; massive; hard, dry; firm, moist; slightly sticky and plastic, wet; violently effervescent; paste pH 7.5.
Cca_2	41-53	Do. Paste pH 7.6.

Cca_3	53-60	Do. Paste pH 7.5.

Parleys Silt Loam—Profile no. 3

This profile was taken in an alfalfa field in the NE¼, Sec. 16, T 6N, R 1W, at Utah State Industrial School near Ogden, Weber County, Utah.

Profile Description

Horizon	Depth inches	
Ap	0-6	Dark grayish brown (10YR 4/2) heavy silt loam, very dark brown (10YR 2/2) when moist; weak to moderate coarse platy breaking to weak fine platy and weak medium granular; slightly hard, dry; friable, moist; slightly sticky and slightly plastic, wet; non-effervescent; paste pH 7.6.
AB	6-13	Brown or dark brown (10YR 4/3) silty clay loam, very dark brown (10YR 2/2) when moist; weak medium subangular blocky breaking to weak fine subangular blocky; thin patchy clay-skins on peds; hard, dry; firm, moist; slightly sticky and plastic, wet; non-effervescent; paste pH 7.7.
B_2	13-20	Dark yellowish brown (10YR 4/4) heavy silty clay loam, dark yellowish brown (10YR 3/4) when moist; weak to moderate medium prismatic breaking to moderate medium subangular blocky; thin patchy clay-skins on peds; hard, dry; firm, moist; sticky and very plastic, wet; non-effervescent; paste pH 7.0.
B_2ca	20-29	Brown (10YR 5/3) heavy silty clay loam, brown or dark brown (10YR 4/3) when moist; weak to moderate medium prismatic breaking to moderate medium subangular blocky; thin patchy clay-skins on peds; hard, dry; very firm, moist; sticky and very plastic, wet; violently effervescent; paste pH 7.7.
Cca	29-42	Pale brown (10YR 6/3) heavy silt loam, dark yellowish brown (10YR 4/4) when moist; massive; hard, dry; very firm, moist; slightly sticky and plastic, wet; violently effervescent; paste pH 8.0.
C_1	42-52	Pale brown (10YR 6/3) heavy silt loam, brown or dark brown (10YR 4/3) when moist; massive; hard, dry; very firm, moist; slightly sticky and plastic, wet; strongly effervescent; paste pH 8.8.
C_2	52-60	Yellowish brown (10YR 5/4) heavy silt loam, brown or dark brown (10YR 4/3) when moist; massive; hard, dry; very firm, moist; slightly sticky and plastic, wet; strongly effervescent; paste pH 8.5.

SOIL SURVEY LABORATORY Logan, Utah October 27, 1958

SOIL TYPE Mendon LOCATION

SURVEY NOS. Site #3 LAB. NOS. U572759 to U572765

Collected: August 2, 1957

	DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
1	0-10		.4	1.1	.6	1.4	7.0	41.9 45.3	44.2	39.7			sic
2	10-14		.3	1.5	.8	1.5	8.3	40.7 36.1	51.5	46.5			c
3	14-22		.1	1.8	.9	1.5	10.1	42.5 35.1	50.5	42.9			c
4	22-29		0	.4	.4	.8	2.9	56.3 49.5	46.0	39.1			sic
5	29-41		0	.3	.4	1.1	2.2	55.2	40.8				sic
6	41-51		.1	.4	.8	1.5	2.6	60.4	34.2				sicl
7	51-60		.1	.2	.5	1.1	2.6	62.9	32.6				sicl

	pH SATURATED PASTE	pH 1:5	Org. Mat. %	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY $EC \times 10^3$ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
1	7.7	8.5	3.82	2.22	.185	12.0	.06	.58	.4				
2	7.4	8.2	1.87	1.09	.099	11.0	.07	.49	0				
3	7.5	8.2	1.38	.80	.086	9.3	.08	.46	.8				
4	7.8	8.5	-	-	-	-	.08	.42	22.0				
5	7.9	8.7	-	-	-	-	.07	.42	32.8				
6	7.6	8.7	-	-	-	-	.06	.43	36.1				
7	8.1	8.8	-	-	-	-	.06	.40	31.0				

	CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS Ca	Mg	H	Na	K (milliequivalents per 100g. soil)	BASE SAT. % EXCH. Na %	SATURATION EXTRACT SOLUBLE Na	K			(milliequivalents per liter)	MOISTURE AT SATURATION %
1	33.7												
2	34.5												
3	35.1												
4	31.4												
5	27.6												
6	25.0												
7	25.9												

SOIL SURVEY LABORATORY Logan, Utah October 27, 1958

SOIL TYPE Mendon **LOCATION**

SURVEY NOS. Site #2 **LAB. NOS.** U572722 to U572728

Collected: August 2, 1957

	DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
1	0-7		.6	.9	1.0	2.6	2.8	51.7	40.4				sic
2	7-13		.7	.9	.8	2.5	2.7	48.6	43.8				sic
3	13-22		.5	.7	.7	2.6	2.3	45.4	47.8				sic
4	22-31		.5	.4	.3	1.5	1.9	49.2	46.2				sic
5	31-39		.1	.3	.3	.8	2.8	56.4	39.3				sicl
6	39-48		.1	.3	.6	1.8	3.7	59.6	33.9				sicl
7	48-60		0	.7	1.1	2.2	4.1	61.8	30.1				sicl

	pH SATURATED PASTE	pH 1:5	Org. Mat. %	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
1	7.8	7.9	6.21	3.61	.272	13.3	.07	.83	3.6				
2	7.7	7.8	4.82	2.80	.218	12.8	.06	.80	1.7				
3	7.5	7.9	3.10	1.80	.142	12.6	.08	.67	.4				
4	7.5	8.3	-	-	-	-	.08	.55	17.2				
5	8.0	8.6	-	-	-	-	.07	.51	38.4				
6	7.9	8.6	-	-	-	-	.06	.45	42.5				
7	8.2	8.6	-	-	-	-	.05	.40	39.8				

	CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS Ca	Mg	H	Na	K (milliequivalents per 100g. soil)	BASE SAT. % EXCH. Na %	SATURATION EXTRACT SOLUBLE Na	K		(milliequivalents per liter)	MOISTURE AT SATURATION %
1	46.0											
2	45.5											
3	35.7											
4	29.1											
5	22.9											
6	22.0											
7	19.4											

SOIL SURVEY LABORATORY Logan, Utah October 27, 1958

SOIL TYPE Mendon **LOCATION**

SURVEY NOS. Site #1 **LAB. NOS.** U572321 to U572327

Collected: July 9, 1957

	DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
1	0-9		.3	.6	.6	1.5	6.0	55.0	36.0				sicl
2	9-14		0	.6	.4	1.0	5.1	49.2	43.7				sic
3	14-26		.3	.5	.3	1.0	3.9	46.8	47.2				sic
4	26-30		.2	.6	.5	1.6	5.0	49.3	42.8				sic
5	30-36		.4	1.0	.5	1.5	5.7	50.0	42.9				sic
6	36-48		0	.8	.6	1.6	4.6	52.3	40.1				sic-sicl
7	48-60		0	.7	.5	1.0	2.6	58.9	36.3				sicl

	pH SATURATED PASTE	pH 1:5	Org. Mat. %	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY $EC \times 10^3$ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
1	7.7	7.9	4.09	2.38	.183	13.0	.06	.80	.3				
2	7.5	7.9	2.10	1.22	.091	13.4	.07	.56	0				
3	7.5	8.0	1.19	.69	.062	11.1	.07	.46	0				
4	7.3	8.4	-	-	-	-	.09	.62	2.6				
5	7.9	8.7	-	-	-	-	.08	.67	20.3				
6	8.0	9.0	-	-	-	-	.07	.68	34.1				
7	8.1	9.0	-	-	-	-	.07	.64	37.2				

	CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS Ca	Mg	H	Na	K (milliequivalents per 100g. soil)	BASE SAT. % EXCH. Na %	SATURATION EXTRACT SOLUBLE Na	K			(milliequivalents per liter)	MOISTURE AT SATURATION %
1	36.3												
2	36.1												
3	39.1												
4	42.9												
5	36.3												
6	30.6												
7	29.0												

SOIL SURVEY LABORATORY Logan, Utah October 27, 1958

SOIL TYPE Mendon **LOCATION**

SURVEY NOS. Site #3 **LAB. NOS.** U572759 to U572765

Collected: August 2, 1957

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent): VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
0-10		.4	1.1	.6	1.4	7.0	45.3	44.2				sic
10-14		.3	1.5	.8	1.5	8.3	36.1	51.5				c
14-22		.1	1.8	.9	1.5	10.1	35.1	50.5				c
22-29		0	.4	.4	.8	2.9	49.5	46.0				sic
29-41		0	.3	.4	1.1	2.2	55.2	40.8				sic
41-51		.1	.4	.8	1.5	2.6	60.4	34.2				sicl
51-60		.1	.2	.5	1.1	2.6	62.9	32.6				sicl

pH: SATURATED PASTE	pH: 1:5	Org. Mat. %	ORGANIC MATTER: ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS: 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.7	8.5	3.82	2.22	.185	12.0	.06	.58	.4				
7.4	8.2	1.87	1.09	.099	11.0	.07	.49	0				
7.5	8.2	1.38	.80	.086	9.3	.08	.46	.8				
7.8	8.5	-	-	-	-	.08	.42	22.0				
7.9	8.7	-	-	-	-	.07	.42	32.8				
7.6	8.7	-	-	-	-	.06	.43	36.1				
8.1	8.8	-	-	-	-	.06	.40	31.0				

CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS (milliequivalents per 100g. soil): Ca	Mg	H	Na	K	BASE SAT. % / EXCH. Na %	SATURATION EXTRACT SOLUBLE (milliequivalents per liter): Na	K				MOISTURE AT SATURATION %
33.7												
34.5												
35.1												
31.4												
27.6												
25.0												
25.9												

SOIL SURVEY LABORATORY Logan, Utah October 27, 1958

SOIL TYPE Mendon **LOCATION**

SURVEY NOS. Site #1 **LAB. NOS.** U572321 to U572327

Collected: July 9, 1957

	DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	
1	0-9		.3	.6	.6	1.5	6.0	55.0	36.0	—		Si l	sicl
2	9-14		0	.6	.4	1.0	5.1	49.2	43.7			Sic l	sic
3	14-26		.3	.5	.3	1.0	3.9	46.8	47.2			sic l	sic
4	26-30		.2	.6	.5	1.6	5.0	49.3	42.8				sic
5	30-36		.4	1.0	.5	1.5	5.7	50.0	42.9				sic
6	36-48		0	.8	.6	1.6	4.6	52.3	40.1				sic-sicl
7	48-60		0	.7	.5	1.0	2.6	58.9	36.3				sicl

	pH		ORGANIC MATTER				EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY $EC \times 10^3$ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		
	SATURATED PASTE	1:5	Org. Mat. %	ORGANIC CARBON %	NITROGEN %	C/N					1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
1	7.7	7.9	4.09	2.38	.183	13.0	.06	.80	.3				
2	7.5	7.9	2.10	1.22	.091	13.4	.07	.56	0				
3	7.5	8.0	1.19	.69	.062	11.1	.07	.46	0				
4	7.3	8.4	-	-	-	-	.09	.62	2.6				
5	7.9	8.7	-	-	-	-	.08	.67	20.3				
6	8.0	9.0	-	-	-	-	.07	.68	34.1				
7	8.1	9.0	-	-	-	-	.07	.64	37.2				

	CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS (milliequivalents per 100g. soil)					BASE SAT. % / EXCH. Na %	SATURATION EXTRACT SOLUBLE (milliequivalents per liter)					MOISTURE AT SATURATION %
		Ca	Mg	H	Na	K		Na	K				
1	36.3												
2	36.1												
3	39.1												
4	42.9												
5	36.3												
6	30.6												
7	29.0												

SOIL SURVEY LABORATORY Logan, Utah October 27, 1958

SOIL TYPE Mendon **LOCATION**

SURVEY NOS. Site #2 **LAB. NOS.** U572722 to U572728

Collected: August 2, 1957

	DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
1	0-7		.6	.9	1.0	2.6	2.8	51.7	40.4				sic
2	7-13		.7	.9	.8	2.5	2.7	48.6	43.8				sic
3	13-22		.5	.7	.7	2.6	2.3	45.4	47.8				sic
4	22-31		.5	.4	.3	1.5	1.9	49.2	46.2				sic
5	31-39		.1	.3	.3	.8	2.8	56.4	39.3				sicl
6	39-48		.1	.3	.6	1.8	3.7	59.6	33.9				sicl
7	48-60		0	.7	1.1	2.2	4.1	61.8	30.1				sicl

	pH SATURATED PASTE	pH 1:5	Org. Mat. %	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY $EC \times 10^3$ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
1	7.8	7.9	6.21	3.61	.272	13.3	.07	.83	3.6				
2	7.7	7.8	4.82	2.80	.218	12.8	.06	.80	1.7				
3	7.5	7.9	3.10	1.80	.142	12.6	.08	.67	.4				
4	7.5	8.3	-	-	-	-	.08	.55	17.2				
5	8.0	8.6	-	-	-	-	.07	.51	38.4				
6	7.9	8.6	-	-	-	-	.06	.45	42.5				
7	8.2	8.6	-	-	-	-	.05	.40	39.8				

	CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS Ca	Mg	H	Na	K (milliequivalents per 100g. soil)	BASE SAT. % / EXCH. Na %	SATURATION EXTRACT SOLUBLE Na	K		(milliequivalents per liter)	MOISTURE AT SATURATION %
1	46.0											
2	45.5											
3	35.7											
4	29.1											
5	22.9											
6	22.0											
7	19.4											

NATIONAL COOPERATIVE SOIL SURVEY
Soil Profile Description

State 1103

SOIL UNIT: Mendon silt loam, 3 to 6 percent slopes MD31/4C-
SURVEY AREA: Cache Area SAMPLE NO: 37-59
LOCATION: 1/8 mile No. of S. 1/4 Corner, Section 1, T13N, R2W. 2 miles North and 1 West of Newton. PHOTO LOCATION: 14G-11
PHYSIOGRAPHY: Medium lake terraces
TOPOGRAPHY AND SLOPE: Moderately sloping, 3 to 6 percent slopes.
ELEVATION: 4,750 feet
PARENT MATERIAL: Mixed lake sediments
DRAINAGE: Well drained, permeability slow, runoff medium.
VEGETATION OR USE: Dry farm - small grains, alfalfa
CLASSIFICATION: Zonal
CLIMATE: Mean annual precipitation: 14-16" Mean annual temperature: 47°F.
COLLECTORS: Mortensen, Carley, Campbell DATE: Nov. 17, 1959

A_{1p} 0-7" Dark gray (10YR 4/1) dry, silt loam, black (10YR 2.4/1) moist; weak medium subangular blocky structure breaking into weak fine granular structure; slightly hard dry, friable moist, nonsticky and slightly plastic wet; noncalcareous; pH 7.6 (cresol red); few fine roots, few fine pores; abrupt smooth boundary.

B_2 7-24" Grayish brown (10YR 5/2) dry) silty clay, black (10YR 2/1) moist; moderate medium prismatic structure breaking into moderate medium subangular blocky structure with thin continuous clay films; very hard dry, very firm moist; very sticky and plastic wet; noncalcareous; pH 7.8 (cresol red); plentiful fine roots, many fine pores; clear smooth boundary.

B_2ca 24-28" Grayish brown (10YR 5/2) dry, silty clay loam, dark grayish brown (10YR 4/2) when moist; weak medium subangular blocky structure breaking into weak fine granular structure, having thin patchy clay films; very hard dry, friable moist, sticky and plastic wet; very strongly calcareous; pH 8.2 (cresol red); few fine roots, many fine pores; gradual wavy boundary.

C1ca 28-34" White (10YR 8/2) dry) silt loam, pale brown (10YR 6/3) moist; massive structure; slightly hard dry, very friable moist; slightly sticky and slightly plastic wet; very strongly calcareous; pH 8.8 (cresol red); no roots, many fine to medium pores; gradual wavy boundary.

C_2 34-40" Light brownish gray (2.5Y 6/2) dry, loam, grayish brown (2.5Y 5/2) moist; massive structure; slightly hard dry, very friable moist, slightly sticky and slightly plastic wet; common medium distinct (10YR 4/4) historical mottles; very strongly calcareous; pH 8.8 (cresol red); no roots, many fine to large pores; gradual wavy boundary.

C3 40-48"+ White (2.5Y 8/2) dry, silt loam, light brownish gray (2.5Y 6/2) moist; massive structure; slightly hard dry, very friable moist, slightly sticky and slightly plastic wet; many medium distinct (7.5YR 4/4) historical mottles; very strongly calcareous; pH 8.8 (cresol red); no roots, common fine to medium pores.

5/3/60

NATIONAL COOPERATIVE SOIL SURVEY
Soil Profile Description

N-952
Established

MD31

SOIL UNIT: Mendon silt loam, 2-3% slopes 3B
SURVEY AREA: Cache
LOCATION: 2½ mi. East of Clarkston

SAMPLE NO: 24-59

PHOTO LOCATION: 24 B-3

PHYSIOGRAPHY: High lake terrace
TOPOGRAPHY AND SLOPE: Gently rolling, 2-3% slopes
ELEVATION: 4,780 feet
PARENT MATERIAL: Lake sediments
DRAINAGE: Well
VEGETATION OR USE: Dryland - wheat & alfalfa
CLASSIFICATION: Zonal - chernozem
CLIMATE: Average annual precipitation: 16" Mean annual temperature: 47°F
COLLECTORS: Campbell DATE: Aug. 10, 1959

A_{1p}	0-6"	Gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist, moderate to fine weak subangular blocky structure; grading to moderate fine granular; slightly hard dry, very friable moist, nonsticky, nonplastic wet; slightly calcareous; pH 8.0 (thymol blue 1:5); plentiful medium to fine roots; abrupt smooth boundary
A_{12}	6-11"	Gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist, fine medium subangular blocky structure, grading to weak fine subangular blocky; slightly hard dry, friable moist, nonsticky, nonplastic wet; slightly calcareous; pH 8.0 (thymol blue 1:5) plentiful fine roots, many fine pores; abrupt smooth boundary.
A_{13}	11-17"	Gray brown (10YR 5/1.6) silt loam, very dark gray brown (10YR 3/2) moist; weak medium subangular blocky structure, grading to weak fine subangular blocky; hard dry, friable moist, slightly sticky, slightly plastic wet; non calcareous; pH 8.0 (thymol blue 1:5); plentiful fine roots; many fine pores; clear smooth boundary.
B_2	17-25"	Gray brown (10YR 5/1.6) clay loam, very dark gray brown (10YR 3/2) moist; weak medium prismatic structure; grading to moderate medium subangular blocky; thin patchy clay skins; very hard dry, firm moist, slightly sticky, plastic wet; non calcareous; pH 8.2 (thymol blue 1:5), plentiful fine roots, medium few pores; clear wavy boundary.
B_{2ca}	25-31"	Light gray (2.5Y 7/2) clay loam, grey brown (2.5Y 5/2) moist, weak medium subangular blocky structure, grading to weak medium to fine subangular blocky; thin occasional clay skins, very hard dry, friable moist, slightly sticky, plastic wet, very strongly calcareous; pH 8.4 (thymol blue 1:5); plentiful fine roots; many medium and fine pores; gradual wavy boundary.
C_{1Ca}	31-40"	Light gray (2.5Y 7/2) clay loam, gray brown (2.5Y 5/2) moist, massive structure, hard dry, friable moist, nonsticky, nonplastic wet; very strongly calcareous; pH 8.4 (thymol blue 1:5); few large, many fine pores, gradual wavy boundary.

SOIL SURVEY LABORATORY Logan, Utah April 16, 1960 #952

SOIL TYPE Mendon sil **LOCATION** Cache - 2½ mi. E. of Clarkston
Sec. 31, T14N, R1W

SURVEY NOS. 24-59 **LAB. NOS.** U593216 to U593222

Collected: August 10, 1959

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
0-6	A_{1p}	0.4	2.3	0.1	4.9	8.3	62.1	21.9				sil
6-11	A_{12}	0.3	2.4	0.1	5.0	8.8	60.7	22.7				sil
11-17	A_{13}	0.6	4.4	0.2	8.7	14.0	49.2	22.9				l
17-25	B_2	0.9	5.5	0.3	10.5	15.6	37.2	30.0				cl
25-31	B_{2ca}	1.0	6.7	0.9	12.0	14.8	34.2	30.4				cl
31-40	C_{1ca}	0.7	5.5	0.6	11.1	15.5	39.0	27.6				cl
40-60	C_2	1.2	6.2	0.8	11.4	16.2	36.6	27.6				cl

pH SATURATED PASTE	pH 1:5	Org. Mat. %	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.8	8.3	2.79	1.62	.129	12.5	.06	1.0	1.4	<1			
7.9	8.4	2.34	1.36	.107	12.7	.04	.8	1.4	<1			
7.7	8.3	1.00	.58	.059	9.8	.04	.6	-	<1			
7.7	8.7	.72	.42	.049	8.6	.07	.6	-	<1			
7.8	8.9	-	-	-	-	.07	.7	15.8	<1			
8.0	8.8	-	-	-	-	.07	.8	24.5	<1			
7.9	8.8	-	-	-	-	.08	1.1		<1			

CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS Ca	Mg	H	Na	K	EXCH. Na %	SATURATION EXTRACT SOLUBLE Na	K				MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
26.3				.4		1						49
25.6				.5		2						49
22.9				.8		3						46
28.4				1.3		5						59
25.8				1.4		5						57
21.9				1.4		6						49
21.3				1.4		7						52

Mendon series - 2

C_2	40-60"	Light gray (2.5Y 7/2) clay loam, gray brown (2.5Y 5/2) moist, massive structure, hard dry, friable moist, non sticky non-plastic wet, very strongly calcareous, pH 8.4 (thymol blue 1:5); many large, medium & fine pores.

Remarks: The A_{12} horizon appears to be a tillage pan. C_1 horizon is salt lake formation. In immediate vicinity the B_2 varies from 7-14" thick, and the B_2ca varies in depth from 28 to 36".

Form UT-1
(Rev. 8/55)
3/3/60

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
National Cooperative Soil Survey
SOIL PROFILE DESCRIPTION

861
Established

Survey Area Blacksmith Fork

Soil type Mendon Clay loam Profile number Comp. symbol

Sec. T R Photo Location Near Mendon

Classification Elev. Average Ann. Precip. Temp.

Parent Material Mixed lake sediments Physiog. Middle lake terrace

Relief 1 Slope %; Length L ; Exposure Runoff class 3 Internal drainage 2

Wt. depth Soil moisture d Vegetation (or crop) alfalfa

Assoc. soils Similar Soils and their differences

Horizon			Ap	B_1	B_2	B_2Ca	Cca_1	Cca_2
Depth			0-10"	10-19"	19-28"	28-37"	37-45"	45-52"
Color	Agg.	D	10YR 5/2	10YR 5/2	10YR 5/2	10YR 6/3	10YR 7/3	10YR 7/3
		M	10YR 2/2	10YR 3/2	10YR 3/2	10YR 5/3	10YR 6/3	10YR 6/3
	Cr.	D	10YR 4/2	10YR 5/2	10YR 5/2	10YR 6/3	10YR 7/3	10YR 7/3
		M	10YR 2/2	10YR 3/2	10YR 3/2	10YR 5/3	10YR 6/3	10YR 6/3
Mottling	M Color		-	-	-	-	-	-
	Char.		-	-	-	-	-	-
Texture			cl	cl+	cl+	cl	cl	cl
Structure	Pri.		2 m cr	1 f sbk	1 f sbk	2 m sbk	2 m sbk	2 m sbk
	Sec.		-	-	-	-	-	-
Coll. Stain			-	c 2 p	c 2 p	-	-	-
Consistence	D		h	h	vh	vh	vh	vh
	M		fi	vfi	vfi	fi	fi	fi
	W		s p	s p	s p	s p	s p	s p
Stability			d	d	d	d	d	d
Lime and/or concretions			eo	eo	eo	eo	eo	eo
Density			m	m	m	m	m	m
pH 1:5			-	-	-	-	-	-
Boundary			-	as	-	as	cs	cs

Remarks

Date April 9, 1959 Observer Bendixen

SOIL SURVEY LABORATORY Logan, Utah January 5, 1960 #861

SOIL TYPE Mendon clay loam **LOCATION** Blacksmith Fork SCD - near Mendon

SURVEY NOS. **LAB. NOS.** U59931 to U59936

Collected: April 7, 1959

DEPTH INCHES	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (per cent): VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	> 2	TEXTURAL CLASS
0-10	Ap											
10-19	B_{11}											
19-28	B_{12}											
28-37	C_{11}											
37-45	Ccal											
45-52	C_{12}											

pH: SATURATED PASTE	pH: 1:5	Org. Mat. %	ORGANIC MATTER: ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM @25°C.	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS: 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.6	8.2	3.92	2.28	.174	13.1	.06	.61	-	-			
7.2	8.0	1.87	1.09	.083	13.2	.09	.50	0	<1			
7.4	7.9	1.27	.74	.087	8.5	.09	.40	0	<1			
7.6	8.6	-	-	-	-	.07	.38	16.3	<1			
7.7	8.8	-	-	-	-	.07	.39	31.1	<1			
7.8	8.6	-	-	-	-	.07	.37	25.6	-			

CATION EXCHANGE CAPACITY ( )	EXTRACTABLE CATIONS (milliequivalents per 100g. soil): Ca	Mg	H	Na	K	EXCH. Na %	SATURATION EXTRACT SOLUBLE (milliequivalents per liter): Na	K			MOISTURE AT SATURATION %
30.0				-		-					-
25.0				.6		2					71
32.8				1.4		4					73
28.2				1.5		5					65
21.8				.6		3					56
				-		-					-